ROADS AND STREETS

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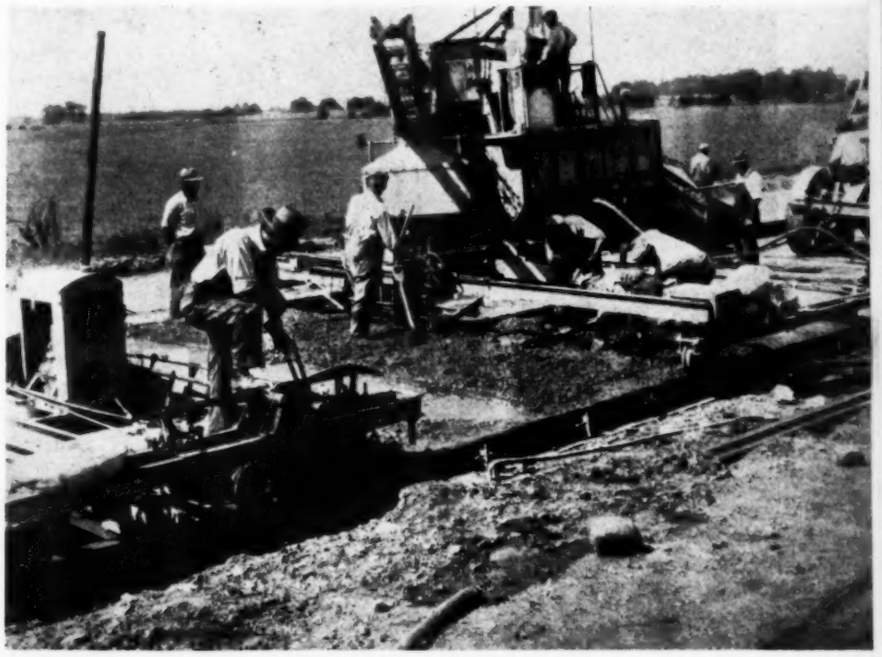
Removing the Cork From the Bottleneck



Concreting Operations on East End of Project. Shows Also Jaicks Joint Machine of Man on Handwheel Which Is Pushing Dowel Bar Through the Joint

Widening Three-Mile Section of Roosevelt Road, 30 Miles West of Chicago

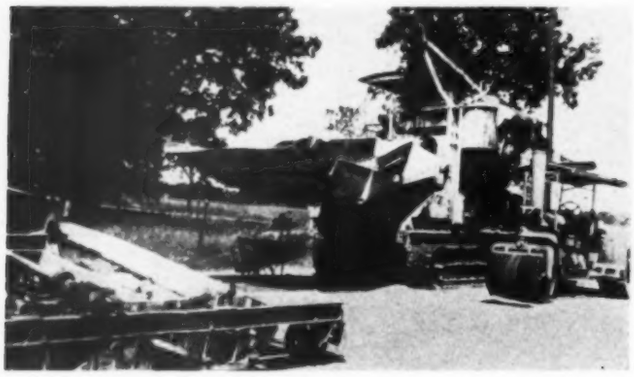
ROOSEVELT ROAD, Illinois Route 6, is bottlenecked for a stretch approximately three miles long about 30 miles west of Chicago. The route has been widened to 40 ft. by the Illinois State Highway Department from a point 10 miles west of the Chicago Loop to Geneva, 35 miles west, with the exception of the bottleneck in DuPage County. Improvement of this latter stretch to the standard 40 ft. width requires a new center line, which for the most part deviates less than 100 ft. from the present road but which does have some new relocation. A feature of the project is the large amount of equipment which is concentrated on such a short stretch of highway. The reason for this is dual: First, the general contractor sublet many parts of the work in order to speedily complete construction for the accommodation of visitors to Chicago's Century of Progress Exposition, and also to do his bit toward unemployment relief; and, Second, on this short stretch of highway are four bridges, one of them a highway grade separation, another an underpass beneath the Elgin, Joliet and Eastern Railroad, a third is a double 50-ft. concrete deck girder, and the last an extension of a 24-ft. slab bridge. A dozen or so culverts and some side drainage with 40-ft. paving and a considerable amount of grading make the bulk of the job. As stated before, all this work is concentrated within a distance of less than three miles. Weather has been ideal for construction and the entire job would have been completed had the state furnished cement on time as required by specifications.

General Plan.—While this project may be termed a widening job, in reality it is all new construction except for the 24-ft. slab bridge and the underpass. The existing concrete slab will be broken up and hauled away. It has considerably more than justified its cost of original construction and maintenance. In fact, a calculation of the economics of the road would show that it has helped to pay the cost of some other portion of the State's hard surfaced mileage. On the portion west of the grade separation contract, which is in about the middle of the project, the new center line is just south of the old road. The east portion is mostly relocation. On the entire project two filling stations and one big barn had to be moved to make way for the new construction. The present Illinois standard cross section and design will be used on the newly established grade line. In the early rush to complete the job on schedule grading was pushed. But because of the delay in receiving cement grass and weeds are growing on the new subgrade except where they have recently been trampled since cement was furnished. The general plan of construction on this bottlenecked road by the general contractor was to lay the slab simultaneously from both ends while the bridges in between would go forward to completion. The grade

separation contract was started last fall and mostly built during the winter.

Labor on all of the highway work in this vicinity is governed by union rules.

East End.—Standard placing and finishing practice, for the most part, is followed by Stanley Jaicks, Oak Park, Ill., subcontractor on the east end of the project. He has varied from standard plant set-up because of



Jaicks Equipment Ready to Start Job, But Waiting for Delivery of Cement. East End of Project, Roosevelt Road

peculiar conditions that obtain. This contractor owns a gravel pit and large gravel plant set-up which is not accommodated with a railroad siding. Hence his cement, which was received by rail about midway from his gravel pit to the site of the job and off the line of travel of the gravel trucks, has to be trucked. Mr. Jaicks decided to truck the sacked cement from the cars to the site of the job and use the flat bed truck as a cement platform. Consequently his procedure is to proportion the aggregates at his gravel pit about 2½ miles from the site of slab pouring, haul the proportioned materials in 3-batch trucks to the job, pull up alongside the cement truck, take on cement and then drive on alongside the slab to the mixer, which is also operating outside of the forms. Another variation from standard construction procedure is this contractor's method of placing contraction joint steel. For this he invented a machine that rolls on the forms. It will be described later. Whether or not it is an economical method of placing contraction joint steel

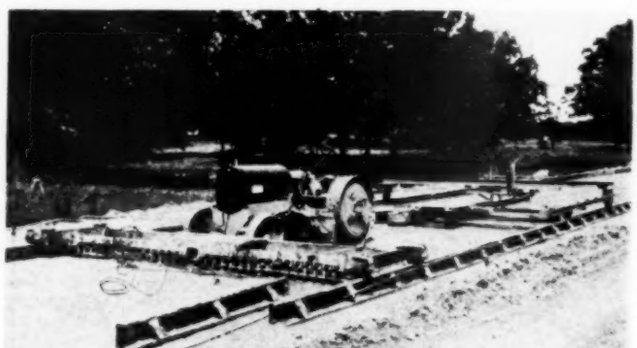
Cement Was Handled by Truck and the Truck Was Used as a Platform From Which Cement Was Dumped Into Batch Trucks That Had Just Arrived from the Pit

depends upon whether or not union rules will require it to be operated by a mechanic and helper if an engine is mounted upon it to make it self operating and self propelling. At present, it is towed along the forms by a Carr form grader.

The double 50-ft. concrete deck girder bridge over the west branch of the DuPage River (really just a fair creek) marks the west end of Stanley Jaicks' contract. From here he pumps water for about 1½ miles through 2½-in. pipe to the east end of the project, where he is now working. About 400 ft. upstream from the pump intake is the outlet of the West Chicago sewage disposal plant.

Following is a list of equipment employed by Stanley Jaicks:

1 *27* E Multi-Foote paver.
1 Ord finishing machine.
1 Austin pup roller.
2 Carr form graders; the new one tows Jaicks' joint machine.
1 Lakewood subgrader.
1 Carr sub-grade template.
1 Warco crawler type 6-ft. blade maintainer.
1 Barnes horizontal triplex pump.
1 Johnson 55-yd. bin and scales.
2 Johnson batchers.
1 Koehring gas crane.
6 Trucks; 2 International, 2 Sterling, 1 Chicago, 1 Indiana.
1 Gravel plant complete.
Several hundred feet of forms.

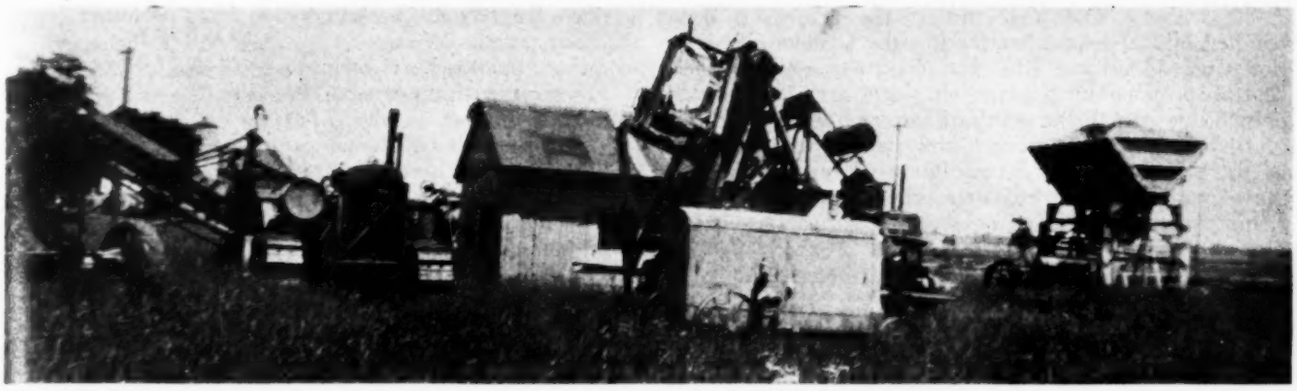


Jaicks Joint Machine in Place on Forms, Towed by Carr Form Grader. Subgrade Tester in Place

All equipment and pipe sizes must be approved by the State Highway Department before a contractor is permitted to use it.

The gang organization employed by Mr. Jaicks differs from that of the Geneva Construction Co., who are handling the west end of the project. Following is the crew as organized on the road:

Formsetting crew—4 men, 1 truck with driver, form-grader operator, foreman.
Fine grade crew—5 men and foreman.
Steel setters—2 men.
Joint machine crew—3 men.
Paver operator and helper.
Water hose and handy men—2.
Puddlers—4 men.
Truck dumper.
Finishing machine operator and helper.
Finishing crew—2 finishers and helper.
Curing—2 men.
Cement dumpers—3 men.
Truck drivers—8.
Crane operator and helper.
Batcher plant operator.
Cement loaders—3 men.
Pump operator.
Water boy.

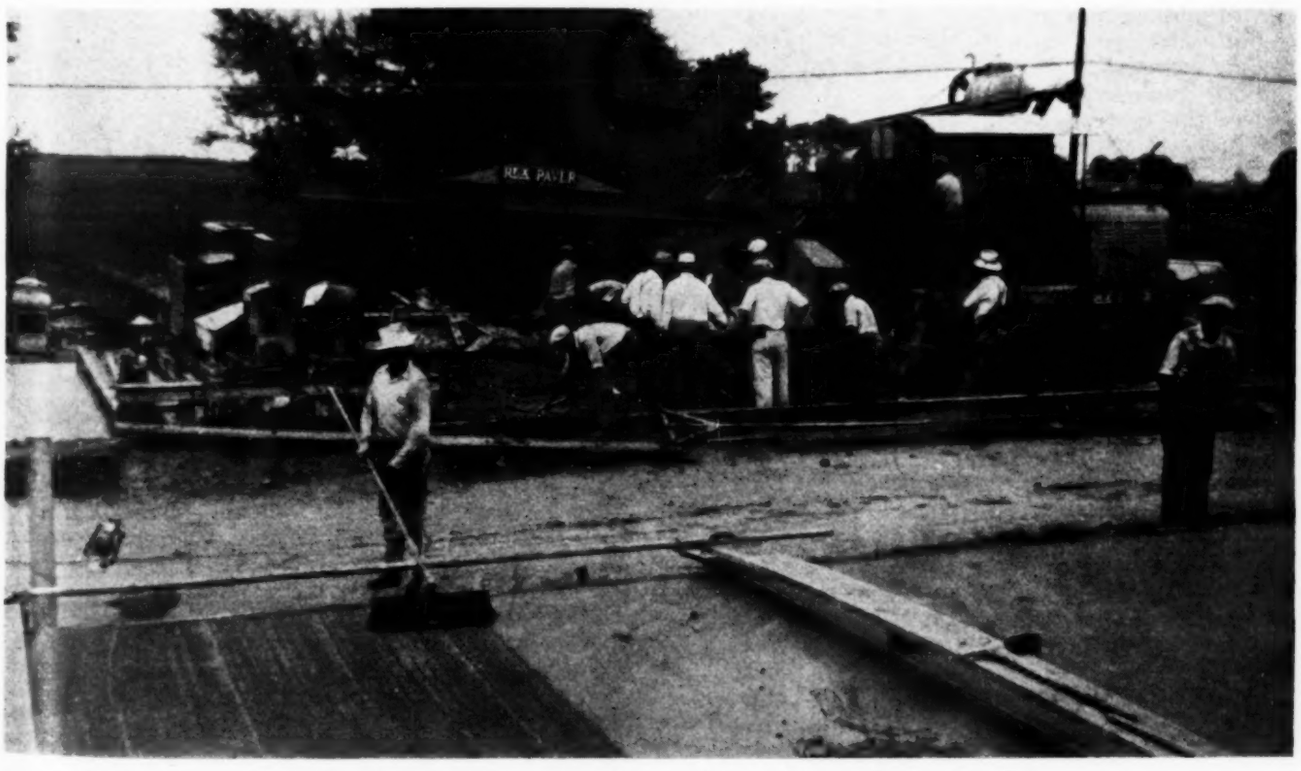


Plant Set Up and Equipment Yard of Geneva Construction Co.; West End of Project, South of West Chicago. Picture Taken While Waiting for Cement

Concrete crew foreman.
Shouldering crew—6 men and foreman.
Superintendent.

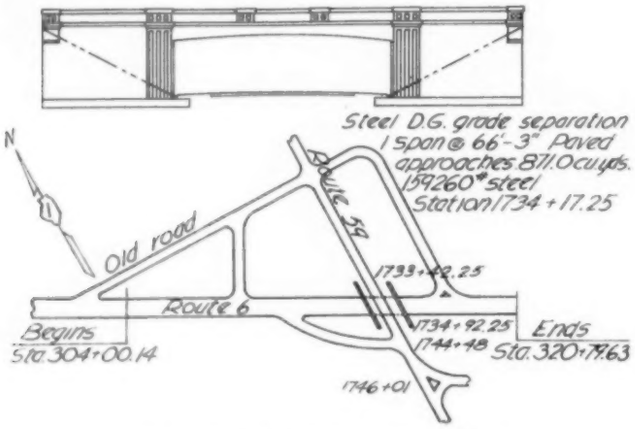
Jaicks' Joint Machine.—The interesting machine invented by Mr. Jaicks for placing the center contraction joint steel rolls on the forms just a little back from and to the side of the mixer. It so travels that concrete from the bucket spills inside of the framework of the machine. This position will be seen in accompanying pictures. As stated before, the machine, at present, is not self-operating. It is being towed by a Carr form grader. The subgrade surface is planked to form a runway and give pulling power for the towing unit.

Essentially the machine is a nearly square steel frame on rollers. Suspended near the ground at the front or towing end is a roll of light gauge steel. The ribbon of steel is rolled like gauze bandage material or adhesive tape is rolled. The spool is supported just off the subgrade and the strip passes against a large wooden roller to guide the strip into a set of dies. Mounted over the roller is a large gong. One revolution of the roller signifies that 5 ft. of ribbon steel has passed into the dies and the big gong rings. This is the signal to the puddler that a dowel must be punched through. As the machine moves forward the steel ribbon passes through two sets of dies at the front end of the machine. These dies deform the flat strip to the standard cross section of the joint. Immediately attached to the die assembly is a follower through which the deformed strip passes to the rear of the machine. Where the metal joint strip emerges from the follower there is a mechanical arrangement mounted on the rear cross member of the machine for punching the dowel bar through the metal strip. As stated before, the concrete is dumped inside of the framework of this machine. It spreads over the follower. Thus, when the joint metal leaves the follower it is in place in the concrete which the puddlers have already spread. Hence there is no necessity for staking it, as must be done when individual short strips of contraction joint steel is employed. The ribbon of steel is caused to unwind from the spool and pass through the dies and follower because the end of the fabricated steel is fastened to the subgrade with a pin while the framework is towed ahead.



Concreting Operations on West End of Project by Geneva Construction Co.

West End.—The west end of the project is being handled by the general contractor, the Geneva Construction Co. of Aurora, Ill. The company established its central proportioning plant on the C. B. & Q. R.R. branch line just to the south of the paving project. The ground is low and swampy, thus necessitating erection of the bins on a spread foundation of railroad ties. A gravel road was built from the subgrade to the proportioning plant. Standard construction procedure is employed.



Sketch Showing Relocation of Road

Following is a list of equipment the Geneva Construction Co. is using on the project:

Grading:
- Austin-Western elevating grader.
- Austin black grader—8 ft.
- Caterpillar Sixty tractor.
- Ford dump trucks.
- Plows, fresnolds, and small tools.

Paving:
- New 27 E Rex paver.
- New No. 11 C. H. & E. triplex pump.
- Johnson bin, scale, and batchers, 55 yd.
- Ord finishing machine.
- Carr subgrader.
- Carr form grader.
- Blaw-Knox forms.
- Koehring crane.
- Trucks—2 and 3-batch, to be hired.
- Rex pumps—auxiliary.
- Concrete Steel Co.'s center strip.

Ditching:
- Barber-Greene ditcher and hand tools.

It is planned to cure the surface with wet burlaps and calcium chloride.

Following is the gang organization which is governed by union rules:

Grading:
- Tractor operator.
- Grader plow shaker and helper.
- Dump boss and helper.
- Blade grader man.
- Six Ford dump truck drivers.
- Grade foreman.

Paving:
- Crane operator and oiler.
- Two men in cars.
- Batcher plant operator (foreman).
- Three cement handlers (cement in cloth bags).
- Teamster and three laborers on rough grade.
- Six fine graders.
- Four form setters and truck driver.
- Steel setter.
- Two handy men checking grade front of mixer.
- Four puddlers.
- Mixer operator and oiler.
- Two cement dumpers.
- Truck dumper.
- Two finishers and helper.
- Finishing machine operator.
- Two burlap men and sprinkler.
- Six-man shouldering crew.
- Timekeeper, also pump operator.
- Grade foreman.
- Concrete foreman.
- Shoulder crew foreman.
- Superintendent.

The contractors are following prescribed rules of working a gang on the 30-hour week basis. Thus, two gangs a week will each work a six-hour shift per day. No work will be done on Saturdays unless rain causes the loss of a week day.

Bridges.—Grouped within 1½ miles are the four largest of the bridge projects. The first on the east is a double 50-ft. concrete deck girder crossing over the west branch of the DuPage River. The contractor, L. E. Meyers Co. of Chicago, who sublet the job to Ernie Swenson, Lockport, Ill., has poured the east abutment. This bridge is on the relocated section and fortunately is in a place where good footing is easily obtained. A steel sheet pile coffer dam holds the hole in shape.

Equipment now on the job consists of the following:
- Marsh-Capron mixer.
- Northwest crane.
- Blaw-Knox clamshell bucket.
- Domestic double diaphragm pump (2).
- Lackawanna steel interlocking sheet piling.
- Starr platform scales.

Grade Separation.—A short distance west of the DuPage River bridge is a grade separation which carries Route 59 over Roosevelt Road, Route 6. The superstructure is a concrete floor and hand rail carried on

Underpass Where Roosevelt Road Passes Under Elgin, Joliet & Eastern Tracks. Old South Abutment Converted Into Center Pier and New South Abutment Poured

arched steel deck girders. Concrete abutments support the superstructure. Drainage is provided so that water falling on the deck of the structure, is conducted by cast iron pipes to catch basins beside the wings of the abutments. These catch basins will also carry water from the surface of the slab of Route 6 where it descends to pass under Route 59. A concrete pipe storm drain, 24 in. in diameter, carries this surface water to the DuPage River.

This job is prosecuted by the John Mackler Co., Chicago Heights, Ill. Besides erection of the grade separation and necessary ramps his contract requires him to excavate the roadway for a distance of 500 or 600 ft. each way. The principal cut necessitated moving about 20,000 cu. yd. of loose rock. In building the structure

the contractor was required to keep the road open to traffic. This job is in the last stage of completion, only the paving and shouldering are left to be built.

Following is a list of the equipment used:

27 E. Koehring paver.
Osgood gas crane.
Osgood steam crane and shovel.
Worthington air compressor.
Rex 10-S mixer.
Nine trucks.
Mall concrete surfacing machine.
C. H. & E. water pump.
2 Jaeger diaphragm pumps.

All Class X concrete was poured before winter was over. If cement had been available the entire job would have been completed by May 15.

Underpass.—A little less than a half mile west of the grade separation is an underpass under the Elgin, Joliet & Eastern R. R. The old underpass is being widened to accommodate the 40 ft. slab. What was formerly the south abutment is being dressed down with pneumatic cutting tools to form a center pier. A new abutment to hold the railroad embankment was just poured. On this

Ready to Pour Concrete for Widening a 24 ft. Slab Bridge South of West Chicago on Roosevelt Road. Picture Taken While Job Was Held Up Waiting for Cement

job Universal cement in paper bags was furnished by the railroad. The job is proceeding nicely. Grading to and away from the underpass has been finished.

Bridge Widening.—Near the west end of the project a 24 ft. concrete slab bridge is being widened at both ends by the Edgar Otto Co. of Downers Grove, Ill. The footing on one side was found to be unsatisfactory and piling were driven. The general contractor sent his Koehring crane to do this work. Swinging leads were attached and a drop hammer used. For mixing concrete the contractor has placed a small Koehring mixer from which concrete will be chuted directly to the waiting form work. A Barnes diaphragm pump keeps water out of the hole. Equipment is moved in and out with a small Cletrac.

For digging the trenches in which the string of culverts were built the contractor used a new Austin Badger ½ yd. shovel.

General Plan.—While this project may be termed a widening job, in reality it is all new construction, so far as the slab is concerned. The existing old road will be broken up and hauled away. It has considerably more than justified its construction. A few culverts and one 24 ft. concrete slab bridge has been widened. On the west half of the project the old road is north of the new center line. The east half is mostly relocation. Two filling stations and one big barn had to be moved to make way for the new construction.

Illinois standard cross section with edge shear bar reinforcing will be employed and a new grade line established. The only fill of any size, while in a swampy place, happens to strike a good foundation so that fill settlement effort will not be required. Grass and weeds are now growing on the graded sections for the full length of the job.

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Working Hours of Truck Drivers

Reiterated and widely circulated charges that commercial highway transportation is an outstanding example of those enterprises in which no serious effort has been made to regulate the hours of labor are refuted by analysis of a survey just made by the National Highway Users Conference, according to Roy F. Britton, director of that organization. "It is misleading for the public to assume that no thought has been given to the question of hours of labor," said Mr. Britton. "The survey just completed shows that the hours of labor have been definitely fixed in 39 states; in approximately two-thirds by the state legislatures and in the remaining third by commission regulations. In 16 states the allowable period of continuous service is fixed at 10 hours, in 14 at 12, in 3 at 14, in 4 at 8, in one at 7, in another at 13.

"Safety was the determining factor," Mr. Britton continued, "in bringing about a limitation of the hours of service. Unemployment is the factor now being considered by the National Recovery Administration. It is argued that if the hours of service already specified in a great majority of the states are further curtailed, it will naturally result in the further spread of work. If new schedules are fixed it may be assumed that the operators of commercial motor vehicles will cooperate as heartily as they did in those states where the principal motive was the maintenance of higher standards of efficiency resulting from the reduction of the hours of continuous service."

The survey of the National Highway Users Conference shows that North Carolina is the one state which has fixed 7 hours as the maximum period of service. Ohio, Oklahoma and Texas placed the maximum at 14 hours, Virginia at 13 hours and Alabama, Indiana, Utah and Idaho at 8 hours.

The states in which 10 hours is fixed as the maximum are: Arizona, California, Colorado, Georgia, Illinois, Massachusetts, Michigan, Missouri, Montana, New Mexico, New York, North Dakota, Oregon, South Carolina, Washington and Wyoming.

Those states in which 12 hours was agreed upon as a maximum period of service are: Arkansas, Connecticut, Florida, Iowa, Kansas, Kentucky, Maine, Minnesota, Mississippi, Nebraska, Nevada, New Hampshire, Rhode Island and South Dakota.

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USE OF COTTON FABRIC MEMBRANE TO BE TESTED ON HOLLAND HIGHWAYS.—The use of cotton fabric membrane in the construction of secondary roads in America has prompted foreign engineers to test further the application of this form of construction to European highways. The Cotton-Textile Institute is advised that three experimental strips employing the cotton fabric membrane are being now constructed in Holland. In one case the fabric, with asphaltic treatment, will be applied directly to the surface of a gravel road. The second test strip will involve the application of asphalt-impregnated fabric to a road which has had several treatments with bituminous surfacing.

State Advisory Boards Appointed to Pass on Public Works Projects

APPOINTMENT of State Advisory Boards under the Federal Emergency Administration of Public Works by President Roosevelt has been announced. Boards of three members were named for every state, with four for Texas, forming the framework of the decentralized Public Works organization on which the plan will be administered with low overhead.

The State Advisory Boards will organize at once and submit to the Public Works Administration in Washington only local projects the State Boards recommend. Their appointment makes possible early submission of none-Federal projects so that unemployed may be returned to jobs in every section of the country.

Secretary of the Interior Harold L. Ickes, announcing the appointments as Federal Administrator of Public Works, said instructions would be sent the boards urging quick action on sound and useful public works projects which will provide employment to large numbers of men in the shortest possible time and elimination of unqualified projects.

An early duty of each State Advisory Board will be to submit to the Administrator an immediate state program. In states where such programs already have been approved by official agencies the State Advisory Board will speedily re-examine the projects before submission to the Administrator. Local government projects which are not approved by State Boards will not be considered at Washington.

The State Advisory Boards announced are as follows:

ALABAMA—Milton H. Fies, Birmingham; Mayer W. Aldridge, Montgomery; Fred Thompson, Mobile. (Mr. Fies is a mining engineer and a graduate of Columbia University. Mr. Aldridge is an accountant and Mr. Thompson, a publisher and owner of several newspapers, was appointed commissioner of the U. S. Shipping Board by President Wilson, reappointed by President Harding and President Coolidge and resigned in 1925.)

ARIZONA—William Walter Lane, Phoenix; Leslie G. Hardy, Tucson; Moses B. Hazeltine, Prescott. (Mr. Lane is state engineer of Arizona. Mr. Hardy is an attorney and former assistant attorney general of Arizona. Mr. Hazeltine is a banker and serving on the advisory board of the regional agriculture corporation.)

ARKANSAS—E. C. Horner, Helena; Haley M. Bennett, Little Rock; John S. Parks, Fort Smith. (Mr. Horner is an attorney and a recognized authority on flood control. Mr. Bennett is active in the cotton industry. Mr. Parks is an editor and a member of the state highway commission.)

CALIFORNIA—Hamilton H. Cotton, San Clemente; Franck Havenner, San Francisco; E. F. Scattergood, Los Angeles. (Mr. Cotton is manager of large estates and a business man. Mr. Havenner, a supervisor of San Francisco. Mr. Scattergood is an engineer and manager of Public Utilities Bureau.)

COLORADO—Thomas A. Duke, Pueblo; Morrison Shafroth, Denver; Miss Josephine Roche, Denver. (Mr. Duke was administrator of the park system of Pueblo, city commissioner and in the fruit and produce business. Mr. Shafroth is an attorney and an overseas artillery commander. Miss Roche is a coal operator and a welfare worker.)

CONNECTICUT—John J. Pelley, New Haven; Archibald McNeil, Bridgeport; Harvey L. Thompson, Middletown. (Mr. Pelley is an outstanding railroad executive. Mr. McNeil, publisher of several papers. Mr. Thompson is a business man who served as state senator.)

DELAWARE—Lee Layton, Dover; Will P. Truit Milford; Wm. Speakman, Wilmington. (Mr. Layton is a graduate engineer and proprietor of a large wholesale grocery. Mr. Truit is a business man and a fruit and grain broker. Mr. Speakman is a plumbing equipment manufacturer.)

FLORIDA—C. B. Treadway, Tallahassee; W. H. Burwell, Miami; T. L. Buckner, Jacksonville. (Mr. Treadway is chairman of the state road department. Mr. Burwell is an attorney and Mr. Buckner a consulting engineer.)

GEORGIA—Thomas J. Hamilton, Augusta; Arthur Lucas, Atlanta; Ryburn Clay, Atlanta. (Mr. Hamilton is an editor who served on papers in Augusta and has been actively identified with the progressive movement. Mr. Lucas has been active in civic affairs in Atlanta and Mr. Clay has been an Atlanta banker.)

IDAHO—Beecher Hitchcock, Sandpoint; Frank E. Johnesse, Boise; Edward C. Rich, Boise. (Mr. Hitchcock is a business man and manufacturer. Mr. Johnesse is a mining and construction engineer and former superintendent of road construction. Mr. Rich has been in the grocery business and active in civic affairs.)

ILLINOIS—Carter H. Harrison, Chicago; James L. Houghteling, Chicago; James H. Andrews, Kewanee. (Mr. Harrison is a lawyer who served five terms as mayor of Chicago. Mr. Houghteling is a newspaper executive and banker. Mr. Andrews is a lawyer, mayor of Kewanee and president of the Illinois League of Municipalities.)

INDIANA—Lewis G. Ellingham, Fort Wayne; Charles B. Sommers, Indianapolis; John N. Dyer, Vincennes. (Mr. Ellingham is a publisher, banker and former secretary of state of Indiana. Mr. Sommers is a manufacturer and Mr. Dyer is a farmer.)

IOWA—Harold M. Cooper, Marshalltown; W. F. Riley, Des Moines; W. P. Adler, Davenport. (Mr. Cooper is a manufacturer of automobile specialties. Mr. Riley is an attorney. Mr. Adler is publisher of six newspapers.)

KANSAS—R. J. Paulette, Salina; Martin Miller, Fort Scott; Ralph Snyder, Manhattan. (Mr. Paulette is a graduate engineer of the University of Missouri, a member of the American Society of Civil Engineers, formerly a director of public works at Salina, served overseas with U. S. Army engineers and an active member of a number of other business associations. Mr. Miller is a banker and former mayor of Fort Scott. Mr. Snyder is president of the state grange.)

KENTUCKY—Wylie B. Bryan, Louisville; N. St. G. T. Carmichael, Kyrock; James C. Stone, Lexington. (Mr. Bryan is a business man and head of a hardware company. Mr. Carmichael is a business man who has served on many boards and commissions in the state. Mr. Stone is former chairman of the Federal Farm Board and president of a tobacco cooperative.)

LOUISIANA—James E. Smitherman, Shreveport; Edward Rightor, New Orleans; James W. Thomson, New Orleans. (Mr. Smitherman is an attorney. Mr. Rightor is a New Orleans civic leader, and Mr. Thomson is a leading newspaper publisher.)

MAINE—James M. Shea, Bar Harbor; John Clark Scates, Westbrook; William M. Ingraham, Portland. (Mr. Shea is a retired contractor. Mr. Scates is a retired banker, former member of the Maine House of Representatives and advocated improved highways. Mr. Ingraham is a former probate court judge of Cumberland county, former mayor of Portland and Assistant Secretary of War under President Wilson.)

MARYLAND—J. Vincent Jamison, Hagerstown; W. C. Stettinius, Baltimore; Charles E. Bryan, Havre de Grace. (Mr. Jamison is a manufacturer and a member of the city council. Mr. Stettinius is a business man and a manufacturer. Mr. Bryan is a business executive.)

MASSACHUSETTS—John J. Prindaville, Framingham; Alvin T. Fuller, Boston; James P. Doran, Brockton. (Mr. Fuller is a former governor of Massachusetts. Mr. Prindaville is a manufacturer. Mr. Doran is attorney and special justice of the Bristol district court.)

MICHIGAN—Murray D. Van Wagoner, Pontiac; Frank H. Alford, Detroit; Leo J. Nowicki, Detroit. (Mr. Van Wagoner was formerly engineer of the Michigan State Highway Department, a drainage commissioner of Oakland county and state highway commissioner. Mr. Alford is a railroad executive. Mr. Nowicki a drainage commissioner of Wayne county, an engineer who was retained for construction work by the Soviet Union.)

MINNESOTA—John F. D. Meighen, Albert Lea; Fred Schilplin, St. Cloud; Wm. N. Ellsberg, Minneapolis. (Mr.

Meighen is a former district judge who served as Minnesota crime commissioner. Mr. Schilplin is a civic leader in the St. Cloud community. Mr. Ellsberg is commissioner of public highways and former city engineer of Minneapolis.)

MISSISSIPPI—Hugh L. White, Columbia; Horace Stansell, Ruleville; Birney Imes, Columbus. (Mr. White served for several years as mayor of Columbia and has been in public works development. Mr. Stansell and Mr. Imes have been active in civic affairs in their districts.)

MISSOURI—William Hirth, Columbia; Harry Scullin, St. Louis; Henry S. Caulfield, St. Louis. (Mr. Hirth is a farm leader and head of a large cooperative farm marketing and processing organization. Mr. Scullin is a manufacturer and has been active in Missouri relief work. Henry S. Caulfield is former governor.)

MONTANA—James E. Murray, Butte; Raymond M. Hart, Billings; Peter Peterson, Glasgow. (Mr. Murray is an attorney and banker. Mr. Hart is a business man and former president of the Billings Chamber of Commerce. Mr. Peterson is a state senator.)

NEBRASKA—John Latenser, Jr., Omaha; John G. Meher, Lincoln; Dan V. Stevens, Fremont. (Mr. Latenser is a leading architect, engineer and builder and former president of the Engineers' Club of Omaha. Mr. Maher is former president of an insurance company and an active business man. Mr. Stevens is a banker and a former member of the House of Representatives and superintendent of schools in Dodge county.)

NEVADA—Robert A. Allen, Carson City; William Settlemeyer, Elko; Ed. Clark, Las Vegas. (Mr. Allen is an engineer, a graduate of the school of engineering, State of Nevada, served as an officer in charge of railway artillery during World War and has large experience in passing on public works. Mr. Settlemeyer is an engineer, graduating from the University of Nevada and a recognized authority on matters pertaining to public works in the state. Mr. Clark is a business man and banker in southern Nevada.)

NEW HAMPSHIRE—Harold Lockwood, Dartmouth College, Hanover; Robert C. Murchie, Concord; Stanton Owen, Laconia. (Mr. Lockwood is an engineer in the Thayer Engineering School of Dartmouth, has assisted in handling government construction. Mr. Murchie and Mr. Owen are lawyers.)

NEW JERSEY—Edward J. Duffy, Temack; William E. White, Red Bank; Walter Kidde, Montclair. (Mr. Kidde is a retired engineer and a former member of the state highway board. Mr. White is a former mayor of Red Bank. Mr. Duffy is a business man and a graduate of Columbia University.)

NEW MEXICO—J. D. Atwood, Roswell; Henry G. Coors, Albuquerque; Felipe Sanchez y Baca, Tucumcari. (Mr. Atwood is an oil producer, Mr. Coors an attorney and Mr. Baca a merchant, all active in civic affairs.)

NEW YORK—Peter G. Ten Eyck, Albany; John T. Dillon, Buffalo; Paul M. Mazur, New York City. (Mr. Ten Eyck is a former congressman who has held many other public offices. Mr. Dillon is head of several engineering companies and a banker. Mr. Mazur is a banker.)

NORTH CAROLINA—Dr. Herman G. Baity, Chapel Hill; John Devane, Fayetteville; Frank Page, Raleigh. (Dr. Baity is a dean in the school of engineering at the University of North Carolina and has a wide and intimate knowledge of the problems of the state. Mr. Devane is a business man engaged in lumber and is a prominent civic leader. Mr. Page is an engineer and banker, former chairman of North Carolina State Highway Commission, and supervised construction of over one hundred million dollars' worth of roads.)

NORTH DAKOTA—Henry Holt, Grand Forks; Stephen J. Doyle, Fargo; Thomas Moody, Williston. (Mr. Holt is a business executive who served as a chairman of the governor's committee on public works. Mr. Doyle is a business man who served as United States marshal for North Dakota under Woodrow Wilson. Mr. Moody is a publisher.)

OHIO—Wm. A. Stinchcomb, Cleveland; Rufus Miles, Columbus; Henry Bentley, Cincinnati. (Mr. Stinchcomb is an engineer who served as director and manager of the Cleveland Metropolitan Park Board. Mr. Miles is director of the Ohio Institute and expert on municipal laws and finance. Mr. Bentley is an attorney.)

OKLAHOMA—John H. Carlock, Ardmore; Frank C. Higginbotham, Norman; Walter A. Lybrand, Oklahoma City. (Mr. Higginbotham served as city manager of McAlester and Sapulpa, Okla. Mr. Carlock is a former state senator. Mr. Lybrand is a lawyer and trustee of the Oklahoma Foundation on Public Welfare.)

OREGON—Bert Haney, Portland; C. C. Hockley, Portland; Robert N. Stanfield, Baker. (Mr. Haney is a former member of the U. S. Shipping Board, former United States district attorney of Oregon. Mr. Hockley is an engineer. Mr. Stanfield is a former United States senator.)

PENNSYLVANIA—Joseph C. Trees, Pittsburgh; A. E. Malmed, Philadelphia; J. Hale Stineman, Lancaster. (Mr. Trees is a trustee of the University of Pittsburgh and an oil and gas operator. Mr. Malmed is a manufacturer. Mr. Stineman is a newspaper publisher.)

RHODE ISLAND—William S. Flynn, Providence; John Nicholas Brown, Newport; William E. Lafond, Woonsocket. (William S. Flynn is an ex-governor of Rhode Island, a Georgetown University graduate, a former member of the Rhode Island House of Representatives. Mr. Brown is a financier and Mr. Lafond is a banker and business man.)

SOUTH CAROLINA—L. P. Slattery, Greenville; Burnet R. Maybank, Charleston; Thomas B. Pearce, Columbia. (Mr. Slattery is an engineer, familiar with all branches of construction and an honor graduate of 1905 class, South Carolina A. & M. College. Mr. Maybank is a business man, mayor of Charleston, educated at Porter Military Academy, College of Charleston, and served in the navy during the World War. Mr. Pearce is a business man and has served as public utilities investigating committee chairman.)

SOUTH DAKOTA—Leon P. Wells, Aberdeen; Herbert E. Hitchcock, Mitchell; S. H. Collins, Aberdeen. (Mr. Wells is former state highway commissioner. Mr. Hitchcock is an attorney and state senator. Mr. Collins is head of the contractors' association.)

TENNESSEE—Col. Harry S. Berry, Nashville; Roane Waring, Memphis; W. Baxter Lee, Knoxville. (Mr. Berry is an engineer, formerly a state highway commissioner, a West Point graduate and served in the army in the Philippines, Mexico, and commanded an artillery regiment overseas during the World War. Mr. Waring and Mr. Lee are attorneys and leaders in civic affairs.)

TEXAS—Col. Ike Ashburn, Houston; S. A. Goeth, San Antonio; John Shary, Mission; R. M. Kelly, Long View. (Mr. Ashburn is a business executive with an excellent military background who has been administrator of various important appointments. Mr. Goeth is an attorney and Mr. Kelly is a business man and manufacturer. Mr. Shary is one of Lower Rio Grande Valley's leading citizens.)

UTAH—Wm. J. Halloran, Salt Lake City; Ora Bundy, Ogden; Sylvester Q. Cannon, Salt Lake City. (Mr. Bundy, a former major in the United States Army Engineering Corps and mayor of Ogden. Mr. Halloran is a leading business man. Mr. Cannon is an engineer of large experience.)

VERMONT—Frank H. Duffy, Rutland; P. E. Sullivan, St. Albans; Lee C. Warner, Bennington. (Mr. Duffy is a former commissioner of public works of Vermont and a banker and business man. Mr. Sullivan and Mr. Warner are active business men.)

VIRGINIA—Henry G. Shirley, Richmond; J. Winston Johns, Charlottesville; Richard Crane, Westover. (Mr. Shirley is state highway commissioner of Virginia and former president of the American Association of State Highway Officials. Mr. Johns is a retired business executive of long experience in the coal trade. Mr. Crane is former president of the Crane Valve Company of Chicago, a diplomat who served as United States minister to Czecho-Slovakia and has long been active in public affairs.)

WASHINGTON—William A. Thompson, Vancouver; C. W. Greenough, Spokane; Roy LaFollette, Colfax. (Mr. Thompson is a transportation executive and president of Vancouver Chamber of Commerce. Mr. Greenough is prosecuting attorney of Spokane county. Mr. LaFollette is an attorney.)

WEST VIRGINIA—D. H. Stephenson, Charleston; William P. Wilson, Wheeling; Van A. Bittner, Fairmont. (Mr. Stephenson is a business man, a pioneer developer of coal, oil and lumber business of southern West Virginia, and formerly a member of the state legislature. Mr. Wilson is a manufacturer and lumberman. Mr. Bittner is a regional official of the United Mine Workers and a labor leader.)

WISCONSIN—Walter G. Caldwell, Waukesha; Wm. G. Bruce, Milwaukee; John Donaghey, Madison. (Mr. Bruce is a publisher, who served on the Milwaukee school board, Milwaukee harbor commission and as tax commissioner. Mr. Caldwell is an engineer and chairman of the highways commission. Mr. Donaghey is a civil engineer and a state highway engineer.)

WYOMING—Patrick J. O'Connor, Casper; Leroy E. Laird, Worland; John W. Hay, Rock Springs. (Mr. O'Connor, a graduate of the University of Dublin has served in the state senate and legislature. Mr. Laird was formerly superintendent of the state highway department. Mr. Hay is a leading banker.)

Functions of the State Advisory Boards are to inform the public of the classes of projects eligible for benefits

under the Public Works Act, to elicit from applicants the supporting data (social, engineering, legal and financial) necessary for examination of the project, to consider the project from the standpoint of coordinated planning, social and economic desirability, provision of employment, diversification of employment, engineering soundness and otherwise in accordance with policies previously outlined by the Special Board of Public Works.

It shall also be the function of the State Advisory Boards promptly to submit to the Administrator all projects recommended, and to advise and assist the State Engineer serving the Public Works Administration in the performance of his function of supervising and policing the performance of contracts.

In states where no officially approved program exists the State Advisory Board will proceed to formulate a program. To this end it may call meetings of state, municipal, and other officers, persons and agencies deemed qualified.

The State Advisory Boards will be instructed to give priority to projects that are socially desirable, economically sound, and which are capable of supplying work to a large number of men in the shortest possible time. The State Advisory Boards will also examine carefully the applicant's financial condition and ability to repay loans asked of the Government.

The Public Works State Advisory Boards will be paid on a $10.00 per diem basis for each member, with pay only for the days that they are actually engaged in Public Works Administration tasks. The Administration feels that men of the caliber appointed will be willing to serve from a sense of public duty at this low rate. Members of State Advisory Boards will be allowed subsistence at the $5.00 per diem rate for days away from home on their public works duties. This is the universal rate for Government agents.

The ten regional advisors will be allowed a $6,000 a year salary. No salaries in excess of this figure are permitted anywhere in the Public Works Administration without action by the Special Board for Public Works on the individual cases.

Each state will be provided with an engineer, appointed by the Federal Administrator and responsible to him. This engineer will be the executive officer of the State Board and the technical expert. He will organize the board's office, direct its small personnel and receive, record and examine all applications made for projects and report to the board on each. These men will be known as the State Engineers of the Public Works Organization, but will be Federal Agents directly responsible to Washington headquarters. The best technical men available from all sources will be drafted for this purpose.

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29,577 Miles of Road Surfaced Last Year, the States Report

Surfacing of 29,577 miles of state highways was completed in 1932 according to information collected from state officials by the Bureau of Public Roads, U. S. Department of Agriculture. On 19,568 miles the surfaces laid were of low type such as sand-clay, gravel and waterbound macadam; on 10,009 miles the surfaces were of higher type.

The state highway systems now include 358,210 miles, an increase of 29,268 miles during the year. The combined systems are reported to have 109,735 miles of high-type surface, 156,325 miles of low-type surface and 92,150 miles still unsurfaced.

The surfacing placed in 1932 was as follows: Sand-clay and topsoil 1,362 miles, gravel (with and without bituminous treatment) 16,864 miles, waterbound macadam (with and without bituminous treatment 1,342 miles, bituminous macadam 1,466 miles, bituminous concrete and sheet asphalt 1,476 miles, Portland cement concrete 6,914 miles, and block types 153 miles.

Details concerning the status of improvement of the state systems are as follows:

State	Mileage in State System	Mileage of low type surfaces[1]	Mileage of high type surfaces[2]
Alabama	5,553	3,002	1,049
Arizona	2,895	1,843	234
Arkansas	9,020	5,478	2,002
California	7,347	2,143	3,134
Colorado	9,136	4,203	467
Connecticut	2,291	1,224	1,018
Delaware	944	96	826
Florida	8,345	3,660	1,398
Georgia	8,264	2,777	1,747
Idaho	4,812	3,003	242
Illinois	10,099	11	8,979
Indiana	8,378	3,994	4,174
Iowa	8,373	3,410	4,375
Kansas	8,982	3,950	1,362
Kentucky	6,842	3,937	1,627
Louisiana	17,505	9,436	2,041
Maine	2,050	1,529	454
Maryland	3,644	1,776	1,868
Massachusetts	1,761	217	1,544
Michigan	8,422	3,936	3,908
Minnesota	6,772	4,299	2,407
Mississippi	6,070	4,697	526
Missouri	10,487	5,648	3,531
Montana	8,177	2,899	59
Nebraska	9,752	5,851	611
Nevada	3,782	1,919	79
New Hampshire	2,862	2,389	437
New Jersey	1,877	117	1,592
New Mexico	10,254	2,898	106
New York	13,947	1,271	10,716
North Carolina	10,033	4,586	4,323
North Dakota	7,591	4,798	21
Ohio	11,759	5,320	6,341
Oklahoma	7,159	2,543	1,900
Oregon	4,574	2,355	1,491
Pennsylvania	34,020	10,976	8,092
Rhode Island	1,070	128	493
South Carolina	5,939	3,191	2,370
South Dakota	5,967	4,565	165
Tennessee	7,226	4,191	2,251
Texas	19,242	2,596	10,106
Utah	4,122	2,183	364
Vermont	1,013	485	528
Virginia	8,154	4,742	1,607
Washington	3,711	2,430	1,017
West Virginia	4,380	1,488	1,980
Wisconsin	10,218	5,880	4,138
Wyoming	3,389	2,255	35
Totals	358,210	156,325	109,735

[1]Includes sand-clay, topsoil, gravel and waterbound macadam.
[2]Includes bituminous macadam, bituminous concrete, Portland cement concrete, and block types.

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TOURIST HIGHWAY PROPOSED IN BAVARIA.—The Bavarian State Legislature has voted to have the Ministry of Interior make a study of a proposed tourist highway, 272 miles long, across the Bavarian Alps from Lindau on the Lake of Constance, to Berchtesgaden, a few miles from the Koenigssee. This route will touch the well known resorts of Fuessen, Oberammergau, Garmisch-Partenkirchen and Bad Toelz, as well as several famous Bavarian lakes. The improvement involves 42 miles of entirely new highway, 151 miles of state roads, and 79 miles of district or county roads. The total cost is estimated at approximately $3,463,000. The cost of an alternate shorter route only 219 miles long, touching more points of interest, but which would be more expensive to construct and maintain, is estimated at about $4,764,000

HIGHWAY IMPROVEMENT—

How to Keep It Sold to the Public

By EDWARD J. MEHREN
President, Portland Cement Association

IN an incredibly short time the highway engineers of this country have built an extraordinary new transportation system. State highways were not out of the dust and out of the mud at our entry into the Great War. In the 16 years that have elapsed we have improved state systems with a total of 373,000 miles, of which 116,000 miles are paved. Over these roads and the secondary systems allied with them travel annually 24 million automobiles, busses and motor trucks, rolling up yearly the astonishing total of 100 billion vehicle miles.

Our railroad system is nothing to be ashamed of; in fact, the largest, most highly perfected in the world. Yet it required something like 70 years to bring it to the state of perfection which highway transportation attained in less than 20 years of intensive development.

By reason of that development we have brought transportation down to the common man, we have greatly widened his radius with all that that means for the broadening of his sympathies and the breaking down of provincialism.

The System More Than the Road.—But we shall be taking too narrow a view of this accomplishment if we regard the highway as the whole of this marvelous development. It is an essential part, but only a part. To make it effective we must include the motor vehicle and an auxiliary equipment involving an enormous capital outlay.

A railroad, for comparison, does not consist only of a track or tracks. To be an operating property, it must include locomotives, cars, terminals and warehouses, coaling and watering stations, repair shops and a dozen additional facilities and accessories.

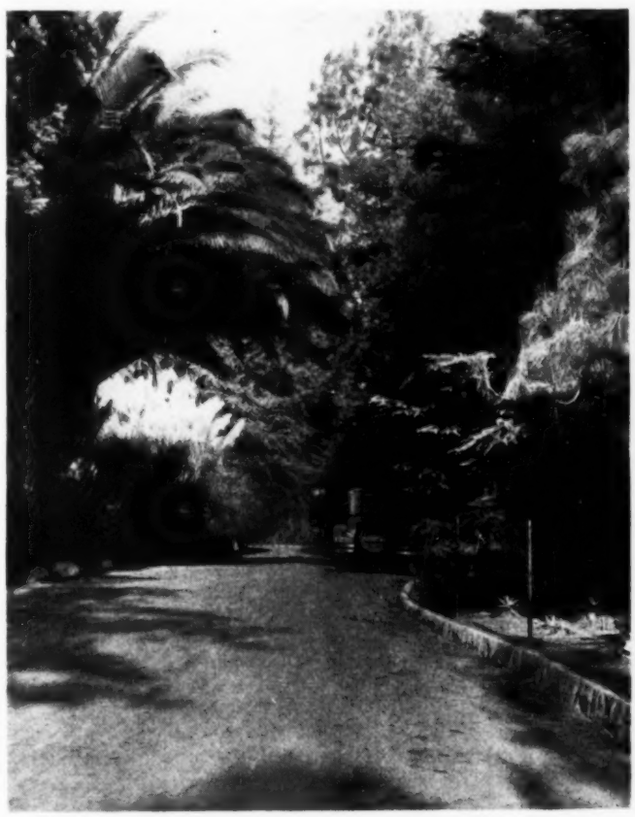
So, too, of a highway system. Beside the highway itself, the track, there are vehicles for both passengers and freight, representing an investment upwards of 5 billion dollars, about the same as the investment in railway rolling stock. There are private and public garages by the millions, filling stations, maintenance and repair shops, tire and accessory stores, parking lots, and other physical items and service accessories.

It is apparent, therefore, that in speaking of modern highway transportation we envision an elaborate grouping of facilities and personnel, none of which can be omitted if the system is to be effective.

Not Under One Management.—Unlike the railroads, the highway transportation system is not under a single ownership and management. In the highway system, however, the public owns, maintains and operates the track; some 20 millions of citizens and corporations separately and independently own the vehicles: while other millions of individuals operate the public garages, filling stations, repair shops, parking lots, etc.

We, therefore, find the anomaly of a great enterprise without a head. This has been a detriment to highway transportation. There has not been a balanced development of the system. There has been no consistent policy. There has been no leadership to forestall, during the depression, the inroads on highway revenues, nor to combat unitedly the disruption of road-building programs solidly planned and carried on for years.

By contrast, notice the vigor, persistence and success of railroad propaganda during this crisis. They have pleaded well their own straitened circumstances, so well that they have been able to draw heavily from the Federal treasury to save themselves from default. While in the very act of using this Federal financial aid, they have builded a backfire of criticism against the highway system owned by the very people whose funds they were accepting through Federal channels.



A Pine and Palms-Bordered Highway in Southern California.

Leadership Needed.—Why this effectiveness of the railways, contrasted with the ineffectiveness of the highway group? The answer is obvious: The railroads have acted in unison. Highways have been headless, disunited.

It is not necessary to remark that such lack of leadership is regrettable, wasteful to the public and detrimental to an orderly development of highway transportation. This exprience points dramatically to the need for leadership. Where shall it be found?

The answer to that inquiry is not easy. But one thing is certain—that until that leadership shall be developed, each state highway department can perform some of the tasks of that leadership. The state highway department represents the motorists of the commonwealth. We might think of it as a corporation—Highways, Inc. The state highway officials, as the managers of such a corporation, would have the duty not only of building,

financing, maintaining and operating the highway system, but

1. Of reporting regularly to the stockholders on the condition and operation of their property;

2. Of developing customers by demonstrating that it is profitable to use the services offered;

3. Of showing the stockholders and users the advantages of expanding the property.

Again, let us use the railroads for comparison. A railroad management reports regularly to its stockholders, giving information about the condition of the property,

A Paved Highway Through a Farming District.

its finances, traffic, and needs. It maintains a traffic department which through advertising and traffic representatives tries to increase both passenger and freight business.

Highway management has the same responsibilities. It must report to its stockholders—the citizens and taxpayers. It must attract users by proving the economy of the service it offers. In so far as it fails to make such reports and to instruct and enthuse the motorists, it will lay itself open to misunderstanding, unreasoned criticism and failure to get the necessary support for the adequate extension of the system.

It is the theme of this short address, therefore, that the state highway department has a responsibility to keep the stockholders and customers of the highway system constantly and fully informed upon the condition of the property and the profitableness of making use of the facilities offered.

Character of Report.—When I suggest that there be regular reports, I do not refer to annual reports issued by both railroads and by highway departments. These are relatively useless in informing and enthusing the multitude. I have in mind the steady flow of information through newspapers and other channels which week by week, and even day by day, keeps the public well informed. The material must have the quality of "news" and must be suffused with a human interest.

Only such material will get an interested reading and will develop a proper understanding of the highway system and its uses.

What Shall We Tell the Public.—The problem of deciding what to tell the public can be divided into two parts, that which interests them as stockholders and that which interests them as users and prospective users.

Citizens and taxpayers, as stockholders, are interested in knowing the condition of their highway system, of its financing, of its operation. Such items as the following will interest them:

1. The size of the highway system, comparisons with railroad systems; investment in the State's highways.

2. The amount and character of traffic on different classes of roads.

We have not fairly begun except in a few states to secure the data needed to portray properly the use of our highway systems. The facts gathered in traffic and economic surveys in Michigan and several other states in coöperation with the Bureau of Public Roads show the possibilities.

The Michigan survey shows that the state highway system, 9 per cent of the total mileage in that state, bears 66 per cent of all rural travel; the county systems, 20 per cent of the total, carry 24 per cent of the traffic, and township roads, 71 per cent of all roads, handle only 10 per cent of the traffic flow. These and other findings definitely show that highway revenues collected by the state should be largely used on the trunk lines.

In Illinois similar figures were produced by a comprehensive traffic survey, and these figures became of immediate use. In this state certain interests were strong in their demand that one-third of the gas-tax revenue be spent on township roads. But facts turned the tide. These interests were shown that the township roads carry only 4.4 per cent of all road and street traffic, and that municipalities contribute 91.1 per cent of gas-tax funds. The unfairness of the request was so well demonstrated that many of the township road proponents withdrew their demands and joined in the advocacy of a more equitable use of the funds.

Such traffic figures are lessons in highway economics, sorely needed if our highway system is to be adequately understood.

3. Operating details, such as signals of the stop-and-go type, direction signs, protection and elimination of crossings with other highways and railroads, offer many opportunities to show how safety is being increased.

4. Maintenance work is but little understood. The organization and location of maintenance forces, the character of their work, the resulting large returns in effective travel, all give opportunities for enlarging upon the highway system as a pulsing, throbbing enterprise on

National Old Trails Highway in Cajon Pass, California.

which thousands of men daily provide for the comfort and safety of the highway user.

5. Construction itself, while it appears very prosaic to the engineer, is an interesting and fascinating operation to the layman. The nicety and precision of present-day construction, resulting in smooth, safe, permanent roads does not need an artist's pen to make them vivid and attractive.

The work of the testing laboratory of the field inspectors furnishes many an interesting tale.

6. The most important feature of present highway operation is its economics. We are beyond the day of the emotional appeal in highways. Hard business facts—the profitableness of the highway to the user—will dominate highway planning from now on. The data referred to previously in discussing traffic studies are of inestimable value here. It is impossible to lay out a sound highway program unless data show whence the revenues are derived. When that is known, automatically the place for their expenditure is determined.

A Highway in Massachusetts.

Furthermore, many a hard battle between opposing interests—the farmers, the users of the county road system, the motorists who want to dash over a great state system, the city contributors to the gasoline tax—are quickly resolved when such data are available.

In this connection, it is vitally necessary that the public understand the distinction between the highway and the land-service roads, the one an artery of transportation, the other a facility to give access to the land. That very distinction shows why the maintenance of the farm road is a proper tax upon farm lands, while motor-vehicle fees should be spent on the main highway system.

7. Finally, there lies enormous and fascinating opportunity in interpreting to the public the future needs of highways.

It was related that more than a hundred years ago a celebrated English civil engineer discouraged a young man who sought his advice by saying that there was no future in England for the civil engineer because he, the great master, had built all of the roads, water supplies and railroads that England would need. It is apparent that the proponents of gas-tax diversion and highway holidays take the same view as the celebrated English engineer. They believe that we have enough of highways, and that they will not need to be rebuilt to higher standards.

All such thinking is, of course, folly. America's railroads in 1900 were in splendid condition and had fine equipment. Since then they and their equipment have been entirely rebuilt and doubtlessly we are on the verge of a new flowering in railroad standards. Three railroads now are talking in terms of light 100-mile-an-hour trains.

The same thing will happen in highways. A generation hence we shall look back and regard the highway systems of today as being in their infancy.

It is the duty of the public-relations specialist of the state highway department to prepare the public for future highway development, picturing the needs, the benefits, the economics involved. What an opportunity to picture to the public first in one way and then in another the ideal highway system—one adequate for the traffic in each area, properly signed and signalled, with grade crossings eliminated, provided with foot paths, night lighting, tree-planted and landscaped roadsides, and comfort stations at intervals.

As part of this business of looking into the future, emphasis might be placed upon the research activities of the highway department, showing how the engineers and other officials are projecting their minds into the future and preparing the way for safer, more comfortable, less hampered traffic.

What Interests the User.—If, therefore, there is great richness in material for the citizen-stockholder, there is quite as much wealth of information for the user and the potential user. Of course, the users and stockholders are more or less identical. Nevertheless there are different types of appeal and each enables the public-relations representative to get across a new phase of his subject.

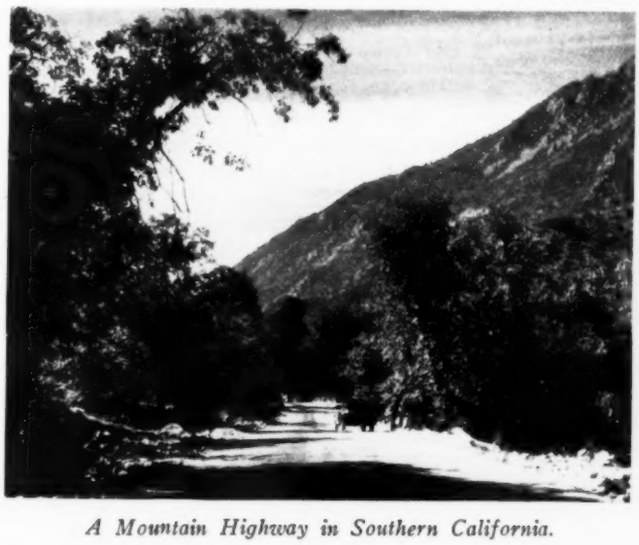
What the user wants to know is what he is getting for his money.

In order to keep this address within reasonable bounds, I shall not endeavor to expand this topic as I did the previous one regarding information for the citizen-stockholder. Suffice it then merely to mention some of the points out of which will flow many an item for newspaper and other use:

The modern road is:

An all weather road
—a dustless road
—a safe road, with easy curves, and a non-skid surface
—well marked and equipped with signals
—with hazardous grade crossings eliminated.
—And, above all, an economical road in which the motorist saves more in cost of car or truck operation than he pays to the state in license fees and gas taxes.

It does not require much imagination to realize the



A Mountain Highway in Southern California.

wealth of material here available for interpretation of the advantages to the user of a well-planned, well-built, well-operated highway system.

How Tell the Story.—Once there is understanding of the material available, the question arises, "How shall it be put before the stockholders and customers?"

An elaborate answer to that question will not be necessary. The imaginations of road officials will expand into proper methods a few simple suggestions:

1. The newspapers are a very obvious channel. They

like to satisfy their readers and readers have an intense interest in highways. Supplied with live, human interest, news from the state highway department, they will eagerly print the material.

2. Another obvious outlet is through addresses to chambers of commerce, Rotary, Kiwanis and other service clubs. They are constantly seeking good speakers and the state highway department which does not train some of its force for effective appearance on the platform is doing itself and the public an injustice.

3. Another outlet consists of various highway-user groups.

Here let me emphasize that in these groups the state highway department has strong allies ready to assist it in any legitimate enterprises that involve the use and development of the highway system. It is not too much to say that the state highway department which does not organize itself for effective contact with these groups is missing a tremendous opportunity to have itself understood and is neglecting allies of great potential power.

Some of these groups are:

a. Automobile clubs
b. Farm organizations
c. Chain-store associations
d. Retail dry-goods associations
e. Automobile and tire dealers
f. Gasoline and oil interests
g. Commercial trucking interests
h. Bus operators.

These groups are in a receptive frame of mind. Their success is linked with the highway. They want to understand its problems; they want to help. They are tremendous powers if rightly mobilized.

Conclusion.—It is impossible in a brief address to expand this topic fully. It is hoped, however, that sufficient has been said to show the opportunity afforded the state highway department to put the highway system in a right light before the citizens, who are both stockholders and users. A commercial organization would not fail to seize it. State organizations may feel less impelled to undertake it. But any reflection upon the diversion of highway funds in this depression and the consequent interruption of highway work, and the disorganization of highway forces, should be convincing that this work cannot be neglected without serious detriment to the highway system, to highway transportation and to the public.

Some few highway departments have attempted to organize this work, but it is safe to say that none has done it adequately or reaped the success that is easily possible. The expense involved is not great.

Acknowledgment.—The foregoing is an address presented June 29 at the Chicago meeting of the American Society of Civil Engineers.

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Sodium Vapor Highway Light

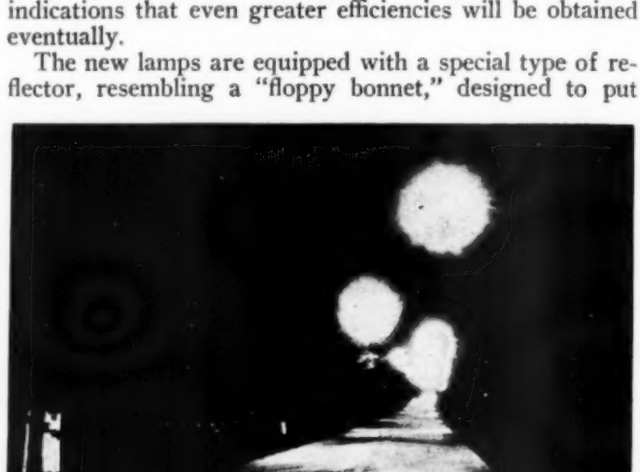
The sodium vapor lamp has been given its American premiere at Schenectady, N. Y., where a half mile of highway has been illuminated, under the joint sponsorship of the General Electric Co. and the New York Power and Light Corporation, with the characteristic orange-yellow glow of sodium vapor. The demonstration embodies the results of many years of research by General Electric physicists and engineers in Schenectady, Cleveland and Hoboken, as well as thorough studies of similar developments abroad.

Twenty-two lighting units have been placed by the engineers, but not more than 18 will be lighted at any one time. They have been so installed that they can be shown in spacing combinations of 125, 250 and 500 ft. for purposes of comparison.

Sodium light is monochromatic, or of one color, whereas daylight is made up of all colors. Monochromatic light is valuable in highway lighting, being especially useful in revealing the details of objects at low levels of illumination, although it has disadvantages in interior lighting where color discrimination is important. The monochromatic light of sodium falls in a region near the maximum sensitivity of the eye. The experimental set-up will determine whether this visual sharpness is an important factor in night driving.

The most important advantage of sodium vapor lamps is their comparatively high efficiency. They can be manufactured with two to three times the efficiency of the tungsten filament incandescent lamp, and there are indications that even greater efficiencies will be obtained eventually.

The new lamps are equipped with a special type of reflector, resembling a "floppy bonnet," designed to put



Section of Highway Lighted by Sodium Vapor Lamp

the light on the road rather than to distribute it in all directions. They were made for this installation by the General Electric Vapor Lamp Co., of Hoboken. By means of a G-E photoelectric control, they are turned on automatically when darkness falls.

The arc in these lamps has the appearance of a neon discharge, somewhat red in color, when the current is turned on. As the lamp is warmed by its heater element, and the arc and the pressure of the sodium increases, the light becomes yellow. At first glance the light from the new lamps seems markedly dim in comparison with incandescent or arc lamps, but seeing is actually made easier by the reduced glare and the monochromatic quality of the light. Sodium lamps for the same wattage input give about 2½ times the light output of the incandescent lamp. This fact, together with the improvement in vision under monochromatic light at low intensities, indicates a very great increase in visual efficiency over the present-day highway lighting systems, without any increase in current consumption. This will be partly offset by increased installation expense.

The lamp itself is a gaseous discharge device, mounted within a "thermos bottle" to conserve heat and maintain the sodium at about 480° F. It is 7 ins. long and less than 3 ins. in diameter, and fits closely within the "thermos" globe. The arc current is carried through the lamp by the gas itself instead of by a filament.

TWELVE MAN-MADE
Obstructions to Research

By HALBERT P. GILLETTE

NO. 1. Excessive deference to authority has been frequently cited as the main reason for so little scientific progress during the first fifteen centuries of the Christian era. It is still one of the obstacles to scientific progress, for no radically new theory is advanced without encountering objections raised by so-called authorities.

No. 2. Geometry was a mature science before any physical science was born. Since deduction from a few principles had led to many mathematical discoveries, it was reasoned that physical science could be developed in a similar manner. This served to retard the experimental method of interrogating nature, and probably was a greater obstacle to scientific progress than obstruction No. 1. Although it is commonly said that progress is no longer retarded by lack of interrogation of nature, there is an amazing amount of purely deductive argument in several realms of science, notably in the science of political economy. That science is still in the "middle ages" of development. One of its greatest expounders, John Stuart Mill, has said that it must always remain purely deductive, because large-scale social experiments can not be made in such a way as to introduce a change in only one factor. He was wrong as to the necessity of changing only one factor in an experiment; and he completely overlooked the possibility of applying observational methods of research such as are applied by astronomers, geologists and meteorologists.

No. 3. Belief in the dominance of accidental effects in nature long stood in the way of interrogating nature either by experiment or by observation. This belief has almost vanished, but in its place has come:

No. 4. Belief in so great a complexity of forces that certain phenomena will long remain inexplainable. This defeatist attitude is well illustrated in the writings of several meteorologists. It has been the attitude of many a half-hearted or incompetent researcher in many a realm of science. Beneath seeming complexity great simplicity may reside. Witness the effect of the discoveries of Kepler and Newton in astronomy, of Huyghens in physics and of Dalton in chemistry.

No. 5. Belief in the direct control of certain phenomena by spirits whose capricious wills could not be fathomed, doubtless served to delay the birth of science for centuries. When this belief faded, another of kindred nature took its place:

No. 6. Belief in discovery by inspiration. It is an amazing fact that this belief persists to such an extent that even inventors and researchers occasionally attribute their initial clues to an inspired vision. They fail to see significance in the fact that prior to the gleam of inspiration there were many hours of seemingly fruitless investigation and thought. The "putting of two and two together" often occurs instantaneously, and may therefore seem inspired. But before such an act of reasoning by analogy occurs, facts must be put into the vaults of memory, and this fact-storing process is apt to be forgotten during the excitement that occurs when a significant relationship bursts upon the mental view. The "burst" is called inspiration. There would be no deterrent to research in calling it inspiration were it not that to do so not only obscures the real mental process but leads many able people to regard discovery and invention as achievements beyond their power. It also leads to skepticism as to the achievements of men regarded as not being inspired.

No. 7. Although early men erroneously endowed certain phenomena with certain human attributes almost as bad an error is committed by most men today, for it is commonly believed that animate phenomena have no kinship with inanimate phenomena. Up to within the last 100 years it was believed, even by chemists, that organic molecular compounds could not be produced artificially. "None of these products of living organisms had at that time been synthesized in the laboratory; they were hence regarded as having been produced by a 'vital force' in organic life, which was not, and never could, be, under the control of the chemist." Although it is now believed that no organic molecule can successfully defy production in the laboratory, it is still believed by most scientists that a living group of organic molecules can not be thus produced. Wherever such a belief persists it will act as an obstacle to research into the nature of the phenomenon called life.

No. 8. Analogous to the belief that animate and inanimate phenomena lack close kinship is the prevalent belief that close kinship is lacking between certain other classes of phenomena. For example, although hydraulics and electrokinetics have certain laws that are astonishingly similar, there persists the belief that this does not arise from a fundamental kinship between these two phenomena. Hence very few efforts have been made to fathom the cause of the similarity in those laws. The same holds true as to light and gravitation. The intensity of each varies inversely as the square of the distance, but this has been regarded merely as an accidental coincidence. Faraday was perhaps the first experimentalist to believe in a basic kinship between light, magnetism, electricity and gravitation. He found that light could be polarized by magnetism, and he found that a magnet could be used to generate electricity. Although he failed to connect gravitation with any of the other three "ethereal phenomena," he remained confident that a connection would be found. Einstein has proved that light gravitates, and is striving to find other relationships between these radiant phenomena. No man-made divisions between phenomena should be allowed to exist in the mind of the researcher. They have retarded, and still retard, discovery.

No. 9. Belief in kinds of forces that can not interact, and in kinds of energy that can not be transformed into one-another, is still prevalent. If the belief is erroneous (and it has been erroneous as to many forces and energies), then it retards discovery.

No. 10. Belief in the perfect exactitude of certain quantitative laws has retarded discovery, because any observed departure from the law was attributed, not to a defect in the law, but either to inaccurate measurements or to extraneous forces. Jevons wisely questioned the perfect accuracy of any quantitative law, and he

raised the question when it was scientific heresy to doubt the exactitude of Newton's law of gravitation.

No. 11. Belief in an extreme simplicity in nature is perhaps as misleading as belief in a complexity that is insuperable. In solving research problems it is often wise to postulate a simplicity that is known not to exist; for, by doing so, inferences can be made and tested. Then, having established the existence of an assumed force or energy, another can be assumed and its existence tested; and so on until a rather complex theory is derived that is in close accord with the facts. Guttenberg's invention of cast-type was a very simple one. Mergenthaler's linotype machine is exceedingly complex. It is much the same with nature. Hence any assumption of extreme simplicity or of extreme complexity in nature should be merely tentative, and not accepted as certain until proved to be so.

No. 12. "False in one, false in all" may be a good legal maxim as to the evidence of a witness, but it is the worst of research maxims. A theory that explains five facts and fails to explain one of a group of six related facts, is still likely to be fundamentally true. The one that it fails to explain may even contradict the theory without destroying its fundamental correctness. Scientific history contains many illustrations of the truth of these statements, yet one defect in a new theory is usually regarded by its critics as being fatal to the entire theory. The fond parent of a theory or of an invention is too often the only person who sees merit in it. When perfection is demanded of a new theory, there is demanded "What ne'er was, nor is, nor e'er shall be."

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A 95-Year-Old Covered Bridge

By GEO. W. STUDABAKER

Resident Engineer, Ohio State Highway Department, Springfield, O.

NINETY-FIVE years of service was brought to a close in 1932 with the wrecking of the old covered wooden bridge which spanned Mad River just west of Springfield, O., on the "Old National Trail."

The bridge was started during the administration of President Andrew Jackson, and was completed shortly after Martin Van Buren took his oath of office in 1837. Engineering of the bridge building was under the direct supervision of graduate engineers of the United States Military Academy at West Point, to whom Congress had awarded the construction of a national highway designed to extend from coast to coat. When it reached a point in Clark County which is now known as Aberfelda, less than a mile west of the bridge site, President Van Buren persuaded Congress to halt construction as a part of his economy program.

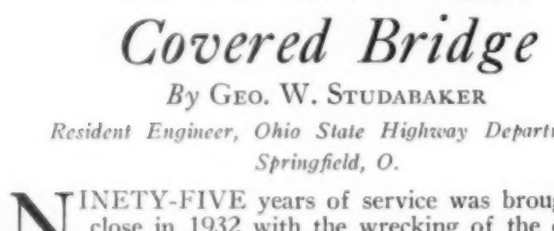
This old bridge had two lanes for traffic, and was 149.9 ft. clear span. It was built by Preston Spinning, pioneer contractor, in the year 1837, and was in almost perfect state of preservation in spite of its many years of service.

In building this bridge approximately 1,300,000 board feet of lumber were used, a dead load of approximately 190 tons. The wood used in the old bridge was principally poplar and oak, and was in such perfect condition that nearly all the main members in the three lattice type trusses were used in the construction of timber bridges over small streams on the state system of highways near Springfield, O.

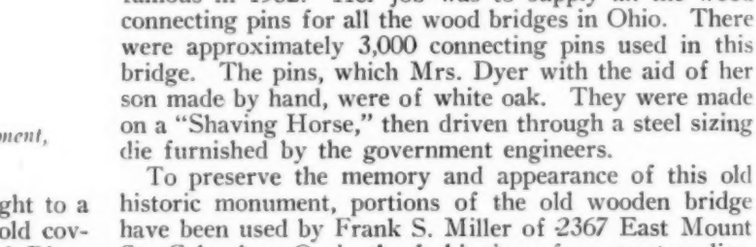
At the time of construction of the old bridge, the horse being the popular means of travel, no doubt a factor of safety was used far in excess of the load the designing engineers thought would be carried, but since the advent of the gasoline age this structure had been samefully overloaded and in many cases loads of 25 and 30 tons were not uncommon. This finally took its toll and the bridge became a potential hazard.

Since the wrecking, some interesting history has come to light in the fact that the federal government in awarding various contracts for the bridge building program on the national road an important one was awarded to a Mrs. Dyer, of Donnelsville, O., whose handiwork on the wooden connecting pins was destined to become famous in 1932. Her job was to supply all the wood connecting pins for all the wood bridges in Ohio. There were approximately 3,000 connecting pins used in this bridge. The pins, which Mrs. Dyer with the aid of her son made by hand, were of white oak. They were made on a "Shaving Horse," then driven through a steel sizing die furnished by the government engineers.

To preserve the memory and appearance of this old historic monument, portions of the old wooden bridge have been used by Frank S. Miller of 2367 East Mount St., Columbus, O., in the fashioning of an exact replica. This model is made up of 3,000 pieces, in exact proportion to the original and one three hundredth its size. It is to be exhibited at the eighty-second annual Ohio State Fair, August 29 to September 3, 1933, after which it is to be permanently loaned to the Clark County Historical Society and placed in the museum in Springfield, O.



The Mad River Bridge as It Was



Dismantling the Bridge

Method of Removing Surplus Filler In Brick Pavement Construction

DURING the season of 1932 the State Department of Highways decided that several experimental projects in brick pavement construction might reveal worthwhile information for future design and construction. In a paper presented at the 27th Annual Meeting of the National Paving Brick Association, Mr. O. W. Merrell, Director of the Department, described some of the work that had been done. That portion of his paper relating to the removal of filler is reprinted below.

To us the most important improvement in the technique of building a brick pavement has been the method for removal of surplus filler during construction. We have carried on some form of this treatment on a number of projects other than the experimental projects mentioned above, and feel that decisive results have been obtained.

This removal is accomplished by coating the brick just prior to the application of filler with one of three different mixtures: whitewash, calcium chloride in solution, or a patented mixture whose trade name is B & B. In the development of the whitewash and the B & B coating, it was the original intention to form a mechanical film on the brick, which would be allowed to thoroughly dry before the application of filler. With this treatment, it was expected that the surplus filler would readily crack off and be removed by traffic. On one or two projects, a power grader was used and about 80 per cent removal was accomplished. Further experimentation proved that all three agents mentioned are most effective when used purely as a moisture applying medium. Let me quote from one particular project, built by a contractor who gave us excellent coöperation, and who took considerable interest in the development of this problem. On the major portion of this project the brick were coated with a thin whitewash consisting of 1½ sacks of spraying lime to 50 gal. of water. This whitewash was applied by means of a hand operated air pressure tank. The type of nozzle and amount of pressure were designed to produce a "fog" which would settle easily onto the surface, rather than being pressure jetted. With the nozzle kept 3 to 4 ft. above the pavement and a fine mist or "fog" of mixture produced, only the surface is coated, and the sides of the brick are untouched. The amount of lime is so small that the brick are scarcely colored, and serves more as a guide to the rate of application of moisture than for any inherent qualities as lime. In normal cool weather, the application of filler followed within 15 to 30 ft. This interval would necessarily be less during hot weather when the brick are dry and more rapidly absorb the moisture.

The asphalt filler was applied with coal scuttles and was simply emptied onto the brick, no attempt being made toward a careful operation. The brick were completely filled, resulting in a heavy coat on top, of from ⅛ to ¼ in. in thickness. Very little manipulation of the surplus coating on top was necessary, being restricted only to those portions where the brick were a trifle too wet, and a small amount of foaming thus ensued. For such localities, a lute similar to a cushion lute was used. No attempt was made to keep the top coating down to any thin film. In fact, the ultimate removal is more successful with a thick coat than a thin one. As the filler begins to cool, but before becoming brittle, workmen with hand sidewalk scrapers mark the coating into strips approximately 2 ft. wide, and then proceed to cut and roll up each strip, very much as a person would roll up a length of stair carpet. Two workmen with tools and one man rolling the material by hand make up a team. One half width of the pavement is filled and cleaned at a time, the filler being rolled from the edge to the center. Here the roll is left and subsequently picked up by the men who filled and operated the kettles. The operation is practically 100 per cent efficient, and leaves a pavement surface entirely free from filler of any kind. Repeated extraction of brick from the pavement so filled and cleaned failed to disclose any unsatisfactorily filled brick.

It appears that there are very few materials or operations that are 100 per cent foolproof or flawless, and the same thing occurs here. In the reheating of the surplus filler so removed, we have thus far specified that the mixture in the kettle be at least 50 per cent new material. The fly in the ointment with this whole process is that the rolling up of this carpet of filler takes with it whatever sand, brick dust, or surplus lime may be on the brick, which is thus introduced into the kettles. Our contractors found to their grief that it was necessary to clean their kettles daily to prevent burned out crown sheets. This is perhaps the most serious difficulty to forestall.

On this particular project there was one man applying whitewash, three men with coal scuttles applying, and six men removing filler. From the best of our records as to final quantity of filler used, it would appear that the value of the asphalt recovered through the removing operation about offsets the extra labor cost. In other words, we should now be able to build a clean surfaced brick pavement at the same price that we formerly paid for one on which surplus filler gave us trouble for two or three years.

The story with regard to calcium chloride is very similar as far as details of removal are concerned. Our experiments with this material have not been quite as extensive as with the whitewash. One method of application is by means of a roller having a cushioned or carpet covered surface on which the calcium chloride in solution is allowed to trickle. Thus the brick are treated with the calcium solution almost like a rubber stamp or blotting operation. The calcium has one advantage over the lime, particularly in hot weather, in that it does not dry nearly as quickly and hence more leeway in the application of the bituminous material is permitted. With whitewash this interval must be watched very closely, while with calcium it may be ten minutes or four or five hours, provided of course, that rain is not falling.

The third material is a patented material, but is essentially a flour and water paste. Like the other two materials the original intention was to permit a thorough drying before the application of the filler, and like the other two it has developed that the distribution of moisture is really the essential operation. In other words, all three materials are simply means of introducing a well-controlled amount of moisture between the brick surface and the filler. It is our contention, however, that this operation should be done carefully and by

competent workmen, with extreme care that the sides of the brick do not become coated.

In our annual specification revision now under way, it is our intention to include these three methods, with perhaps further leeway given the contractor in developing any other agent he may find successful in producing the desired result. We in Ohio feel that we have demonstrated that this feature alone will be a big help in producing a satisfactory high type pavement with a nonskid, pleasing riding surface.

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Regional Advisors Appointed for Federal Public Works Program

Ten regional advisors to the Federal Emergency Administration of Public Works have been appointed by President Roosevelt and headquarters for the ten regions into which the National has been divided announced.

These advisors will serve as direct representatives of the Federal Public Works Administration in the decentralized organization being set up to expedite the program of useful public works designed to give speedy employment and move men from relief rolls to pay rolls.

Secretary of the Interior Harold L. Ickes, as Public Works Administrator, made public the appointments and called upon various local governments seeking aid of the Public Works Administration to present only projects qualified under the announced policies of the administration.

These non-Federal projects are to be presented to the State Advisory Boards, the personnel of which are given elsewhere in this issue.

The regional advisors, together with the headquarters are as follows:

REGION 1

Advisor—Ralph L. Cooper of Belfast, Me. (Mr. Cooper is a native of Maine, educated at the University of Maine, a business man and a former member of the state legislature.)

Boston will be the headquarters of the region which consists of Maine, Vermont, New Hampshire, Massachusetts, Rhode Island and Connecticut.

REGION 2

Advisor—Edward J. Flynn of New York City. (Mr. Flynn is the Secretary of State of New York.)

New York will be the headquarters of the region which consists of New York, Pennsylvania and New Jersey.

REGION 3

Advisor—Daniel J. Tobin of Indianapolis, Ind. (Mr. Tobin is a leader of labor, a former treasurer of the American Federation of Labor and has served on many trade union and Government committees.)

Chicago will be the headquarters of the region which consists of Illinois, Indiana, Michigan, Ohio and Wisconsin.

REGION 4

Advisor—Frank Murphy of Wheaton, Minn. (Mr. Murphy is a lawyer, president of the Minnesota State Bar Association and a farm leader.)

Omaha will be headquarters for the region which consists of North Dakota, South Dakota, Nebraska, Minnesota, Iowa and Wyoming.

REGION 5

Advisor—N. Marshall Dana of Portland, Ore. (Mr. Dana is editor of the Portland Journal.)

Portland will be headquarters of the region which consists of Montana, Idaho, Washington and Oregon.

REGION 6

Advisor—Justus S. Wardell of San Francisco, Calif. (Mr. Wardell for many years was editor and publisher of the Daily Journal of Commerce, served in the Internal Revenue Department under President Wilson, and was a candidate for Governor of California in 1926.)

San Francisco will be headquarters of the region which consists of California, Nevada, Utah and Arizona.

REGION 7

Advisor—Clifford Jones of Spur, Tex. (Mr. Jones is former president of the West Texas Chamber of Commerce, president of Texas Technical College Board and business man of large experience in public works and has been active in civic movements and director of the Fort Worth and Denver Railroad.)

Fort Worth will be headquarters of the region which consists of Texas, Louisiana and New Mexico.

REGION 8

Advisor—Vincent M. Miles of Ft. Smith, Ark. (Mr. Miles is a lawyer, a graduate of the University of Virginia, an overseas infantry commander who took part in the St. Mihiel offensive and was in the army of occupation in Germany.)

Kansas City, Mo., will be headquarters of the region consisting of Colorado, Kansas, Oklahoma, Missouri, and Arkansas.

REGION 9

Advisor—Monroe Johnson of Marion, S. C. (Col. Johnson is a world war overseas officer, a business man, and an active participant in American Legion affairs.)

Atlanta will be headquarters of the region consisting of Mississippi, Alabama, Georgia, South Carolina and Florida.

REGION 10

Advisor—George L. Ratcliffe of Baltimore, Md. (Dr. Ratcliffe is a graduate of Johns Hopkins University, a lawyer, the former Secretary of State for Maryland and a banker.)

Richmond will be headquarters of the region which consists of Tennessee, Kentucky, West Virginia, Maryland, Delaware, Virginia, and North Carolina.

Functions of the regional advisors will consist of obtaining from the State Boards within the region lists of projects under consideration by them together with recommendations or rejections. Each regional advisor will from time to time visit the offices of the State Boards within the region and advise and consult with those boards to the end that action may be consistent with sound local and district planning.

The regional advisors will keep the national planning board in Washington advised of developments and accumulate, collate and submit to the Washington planning board all available information useful to it.

The advisors will also serve the Federal Public Works Administrator in any manner that he may order for the purpose of speeding up the work, investigating and solving such problems as may arise.

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HIGHWAY EXPENDITURES IN GERMANY.—It is estimated that around 750,000,000 Reichsmarks (Reichsmark 24 ct.) a year are expended on German highways in normal times. In 1929 such expenditures amounted to about 810,000,000 Reichsmarks, falling to approximately 300,000,000 in 1932, most of which was used for urgent maintenance work.

The Relation of Geological Formations to Road Material Surveys

By D. G. RUNNER

Assistant Materials Engineer, U. S. Bureau of Public Roads.

THE importance of good, accurate material surveys is greater now than ever before, because of the lesser amounts of highway funds available to meet the increasing demands for highway service. A large number of state highway departments have made, or are in the process of making, complete surveys of their deposits of mineral aggregates. The information accumulated by these surveys is of inestimable value in developing a construction program for highway systems. Maximum economy in the cost of construction depends upon the fullest possible utilization of the nearest available materials, either local or commercial. The character of this available material is often one of the factors which determine the type of construction to be employed.

In a previous article* by the writer, a method of procedure for making material surveys was presented in detail. The purpose of this article is to describe briefly a few geological formations which are likely to be encountered in making a survey, and their effect upon the amount of material which may be economically recovered. Although these geological formations by no means cover all possible cases, it is believed they are important enough to warrant discussion. It must be recognized, however, that these conditions are generalized and may not be applicable to all regions of the United States. As is brought out in the descriptions, the formations may have considerable bearing upon the amount of material available and the ultimate cost of removal.

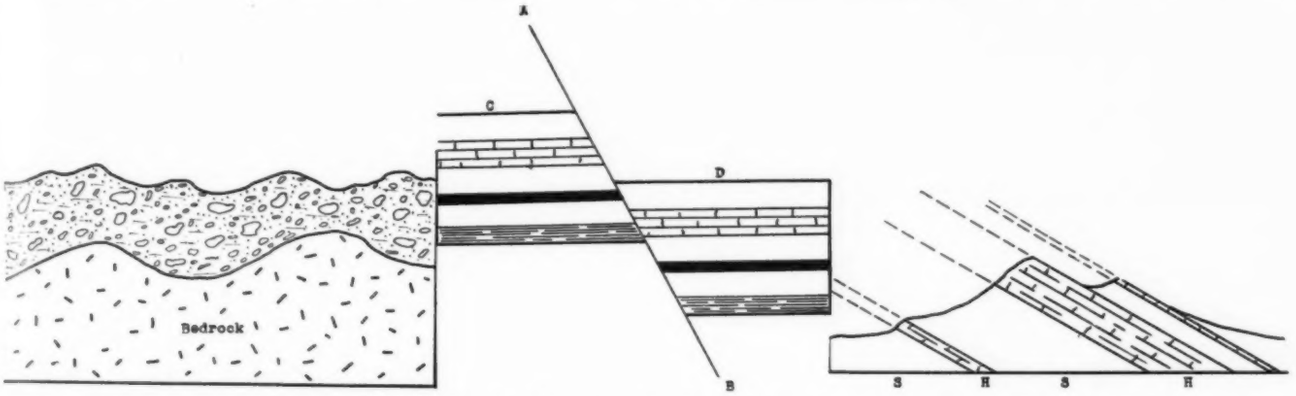

Fig. 1.—Cross Section of a Deposit of Unconsolidated Glacial Material Upon Bed Rock.

Fig. 2.—Diagram of a Normal Fault in Horizontal Beds. A-B: Fault Line; C: Upthrow Side; D: Downthrow Side.

Fig. 3.—A Hogback, Due to the Slower Erosion of the Hard Stratum. S: Soft Strata; H: Hard Strata. (After Cleland.)

In the search for rock and sand-gravel deposits, care must be exercised in estimating the amount of material which can be economically removed. Regardless of the quality of the materials, if the overburden is heavy or the gravel formation is "thin," there is no point to be gained in using local supplies. For example, deposits of sand-gravel in glaciated regions may be of inadequate

*See reference number 6 in list of selected readings.

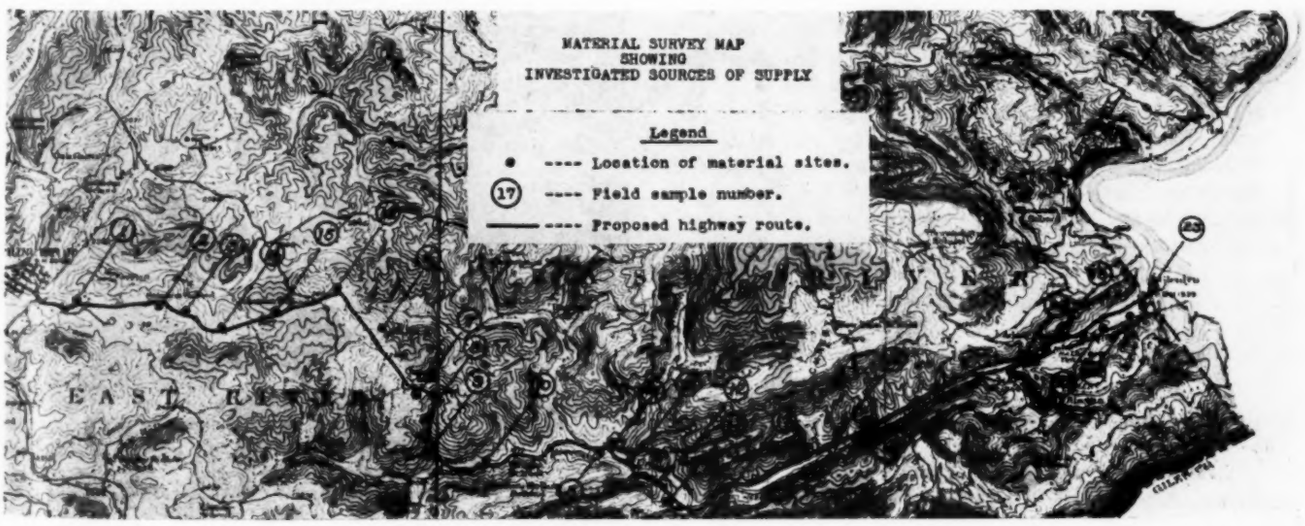

Fig. 4.—Material Survey Map, Showing Investigated Sources of Supply. U. S. Topographic Sheet Used as a Base Map.

Upper Left: Fig. 5.—View of Pit and Crushing Plant on Federal Aid Project 175-A, near Folsom, New Mexico, on Route U. S. 64. (Photo by Courtesy of New Mexico State Highway Department.) Upper Right: Fig. 6.—View of Pit, Crushing and Screening Plant on Federal Aid Project 88-G, near Santa Fe, New Mexico. (Photo by Courtesy of the New Mexico State Highway Department.) Lower Left: Fig. 7.—Local Plant Producing Separated Sizes of Material. (Photo by Courtesy of the Wisconsin Highway Commission.) Lower Right: Fig. 8.—Gravel Pit Located near Scherr, West Virginia. 5½ Miles of Project 3215-A Surfaced with Material from This Pit. (Photo by Courtesy of West Virginia State Road Commission.)

depth to warrant removal of the aggregate. Reference is made to Fig. 1, in which the glacial material is shown as resting upon bedrock. The thickness of this gravel cover may vary from place to place and within comparatively short distances. As may be seen from the figure, the amount of material which can be removed is variable. The contact between the bedrock and the unconsolidated material is clearly defined for the reason that the loose soil was removed by the scouring action of the ice, thereby leaving only the solid bedrock as a foundation for the sand-gravel. Hence, it is essential that glacial deposits be thoroughly test-pitted to determine the approximate thickness of the formation. Then too, the geology of the surrounding region should be carefully studied as a further aid in the materials investigation.

The fault is a geological structure, commonly found in some parts of the country, which is likely to cause difficulty in quarrying. A fault may be defined as a fracture in the rocks of the earth's crust, in which displacement of one side with respect to the other along the fault plane, has taken place. By referring to Fig. 2, which is a diagram of a normal fault, it may be noted that the horizontal strata have been separated and that one side has slipped downward. This movement may be only a few inches or as much as hundreds of feet. Usually, faults result from tension, compression or torsion in the earth's crust. From the diagram it is evident that in quarrying a rock outcrop through which a fault has occurred, the strata may abruptly end, or change into a formation entirely dissimilar to the one being worked. This change in the character of the deposit can completely alter the amount of material which can be economically removed from the site. Generally speaking, a fault area may be located by one or more of the following field indications:

1. Evidence of strata displacement on opposite side of the fault line.
2. By repetition of the same stratum.
3. By lines of springs.
4. By omission of strata.
5. Often faults may bring together two or more strata of unequal weather resistant properties, with the possibility that the harder stratum will project above the softer one, thereby producing an elevated ridge.

Figure 3 illustrates another geological structure which may cause difficulty in quarrying. This diagram is highly generalized, but shows that an outcrop of this character should be carefully investigated before assuming that a definite quantity of material could be removed. It may be seen from a study of the figure that a stratum of rock, dipping steeply, is more resistant to weathering than the adjacent rock. A structure of this kind is called a "hogback," and often reaches a height of several hun-

Fig. 9.—Windlass Used in Test Pitting. (Photo by Courtesy of the Wisconsin Highway Commission.)

Fig. 10.—Plant Producing Local Materials for a Concrete Paving Job. (Photo by Courtesy of Wisconsin Highway Commission.)

dred feet. If quarrying should be started at the face of the outcrop it is evident that, due to the sharp dip of the strata, the amount of overburden would increase as the rock is quarried. "Hogbacks" are commonly found in regions of disturbed strata, where initial foldings and displacements have taken place.

In the publication referred to† at the beginning of this article mention was made of a topographic map, which should accompany the material survey report. Figure 4 is a reproduction of such a map. A map of this kind is of value in drawing up the preliminary plans, and in showing the location of the material sites with reference to the right of way. It shows immediately the number of material sites located, together with the character of the country through which the proposed road is to be constructed. Maps of this kind, while not essential, are of great assistance to those persons charged with construction of the highway.

Figures 5 to 10 are included in this article to show what is now being done in the field of utilization of local materials, in widely separated sections of the United States. These photographs were supplied by the state highway departments of New Mexico, Wisconsin and West Virginia, and are hereby gratefully acknowledged.

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†See footnote 1.

A Power Shovel Equipped with a Giant Hammer

Among hand-tools none is either more antique in origin or more commonly used today than is the hammer. In construction work the pile-driver is the only commonly used hammer of giant size, but it is limited in application. The inventor of the power hammer that is shown herewith had evidently experienced the need of a hammer that would be almost as flexible in application as the hand hammer but vastly more massive. There is Thor's great hammer greatly magnified, and so designed as to be quickly attachable to the boom of a Keystone power shovel.

The hammer weighs 3,000 lb. and acquires its velocity not merely by falling 5 to 10 ft. but by receiving a sharp pull on the hauling line at the beginning of the drop. Thus 20 blows can be delivered per minute with a mass weighing 1.5 tons. The hammer head has a removable striking face that may be of any desired shape, ranging from a flat surface to a pickpoint. In less than two hours the power-shovel bucket can be removed and the patented giant hammer attached. No change is made in the boom in making this transformation from shovel to hammer.

Among the uses to which this giant hammer may be put are: Breaking boulders, strata of rock in place, frozen earth, concrete and macadam pavements, etc.

A New Convertible Shovel Utility. The Hammer Weighs 3,000 lbs. and Is Capable of Delivering 20 Blows Per Minute

Castings and old concrete structures can be demolished with the hammer. In quarrying rock for crushing, chunks too large to enter the crusher often occur, and can be broken up with this hammer. It can also be used for tamping backfills in trenches and the like, and for driving fence posts, short piles and trench sheeting.

This giant hammer makes the fourth attachment that the Keystone power-showel provides, the other three being (1) the skimmer or plunger for excavation above grade, (2) the pullscoop or "trench hoe" for excavation below grade, and (3) the short boom extension for crane or clamshell work. Each of these four utilities is attachable to shovel boom without changes in the boom, and the interchange can be made in less than two hours.

This ingenious power hammer is made by the Keystone Driller Company of Beaver Falls, Pa.

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Snyder Appointed Chief Engineer in Kentucky. —W. O. Snyder has been appointed chief engineer of the state highway department of Kentucky. He has been with the department since 1920.

HIGHWAY-RAILWAY BRIDGE

Erection Methods for 280 Ft. Deck Truss Spans

A COMBINATION highway and railway bridge, one of the largest in Western Canada, was completed recently over the Saskatchewan River at Nipawin, Sask. The bridge has a total length of 1,908 ft. between abutments and comprises for 280-ft. deck truss spans over the river flanked by a steel trestle approach 516 ft. long at the north end and one of similar construction 276 ft. long at the south or Nipawin end. These trestle approaches are composed of 45-ft. spans over the towers and spans about 75 ft. long between the towers.

On the 280-ft. spans the railway is carried at the upper chord lever and the highway is located immediately underneath (between the trusses) at the level of the lower chords. Where these combination railway and highway spans join the steel trestle approach at each end, the highway swings out from underneath the railway and runs alongside the railway trestle on separate spans. This separation is effected at each end by using independent highway spans between the extreme piers and the adjacent steel towers of the railway trestle—these independent spans being "skewed" by having one end supported on an outer pier and the other end carried by steel supports cantilevered from the near bent of the adjacent steel tower. From that point to its junction with the river banks the highways is carried part of the distance on independent steel spans and part on a timber pile trestle.

The structure is designed for a live load equivalent to Cooper's E-60 on the railway deck and 15 ton trucks on the highway deck. The highway has a clear width of 16 ft. between curbs and 17 ft. 6 in. clear between handrails. The piers supporting the truss spans are over 112 ft. high from bed of river to bridge seat level and about 127 ft. high from foundation to bridge seat. The total height from foundation to track level is about 170 ft. and the clear height of the truss spans above ordinary high water lever is 95 ft.

A paper dealing with the design and erection of this bridge was presented March 23 before the Montreal Branch of the Engineering Institute of Canada by Major A. R. Ketterson, Assistant Engineer of Bridges, Canadian Pacific Ry. That portion of the paper relating to the erection of the long spans over the waterway is abstracted below.

As the construction of the substructure proceeded, it became evident that erection of the superstructure would not begin until late in July when the water level would be low, and it was, therefore, decided to erect span No. 1 on falsework in its final position and cantilever the other three spans.

When spans are intended to be "simple supported" in service, but are erected as cantilevers throughout their length, it is often the case that certain members near the support from which the span is being built out are called upon to resist greater stresses during erection than they will in service, and for that reason it is necessary to provide such members with a considerable excess of material over and above their service requirements—this material being of course redundant as far as the finished structure is concerned. In order to reduce this redundant material to a minimum and to increase the vertical stiffness of the cantilever trusses during erection, the temporary tension members, which were introduced to provide the necessary continuity over the supports during the erection of the major portion of the span sloped upwards from their connection to the fourth panel on the top chord of the cantilever trusses and, passing over the top of a post erected at the second panel

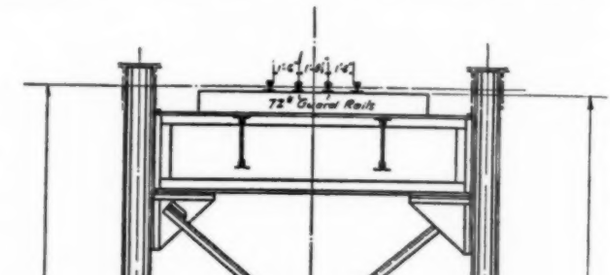

Fig. 1.—Typical Section Through Deck Truss

point on the top chord of these trusses, then over the top of a post erected at the corresponding point (relative to the support) on the anchor trusses from which they sloped downward to their connection with the fourth panel of the anchor trusses. (See Fig. 2.)

This temporary harness, which could be moved ahead for use on the succeeding span, had the effect of deepeing the trusses in the vicinity of the piers during erection, with the result that the material required for erection stresses in the members near the support (with the exception of the lower section of a diagonal and one post on each side of the center line) did not exceed that required in the same members with the spans in service and carrying their maximum live load on the railway track and the highway deck. This condition was further assisted by the fact that each member of the trusses had its quota of material provided to resist stresses due to

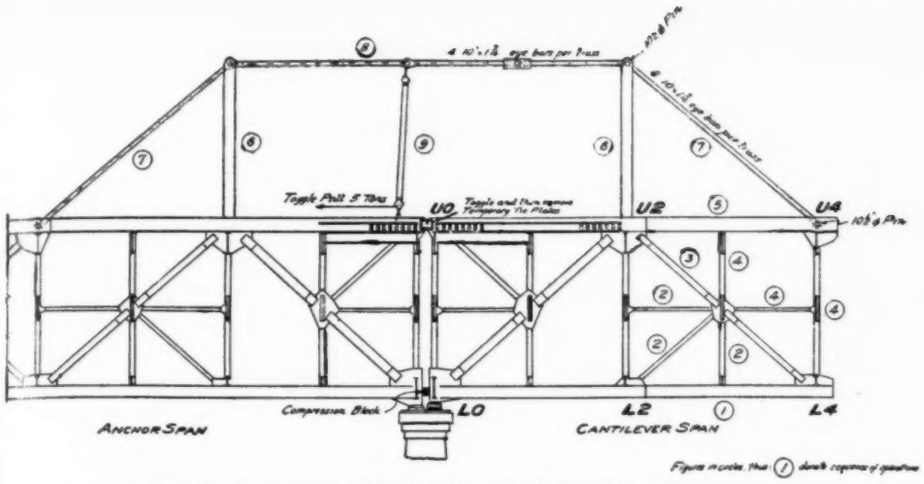

Fig. 2.—Temporary Harness for Cantilever Erection

Figure 2 indicates the extent of the erection when the harness was introduced, and the system of "toggling" in order to transfer the tension in the tie plate at *UO* to it.

The tension members of the harness were comprised of a chain of eye bars engaging 10½ in. diameter nickel steel pins at these connections. Each of the inclined members, which were designed for a tension of 1,040 tons per truss, consisted of a group of six 10-in. by 1 7/16 in. bars. The horizontal members joining the top of the posts were designed for a pull of 790 tons per truss and consisted of a group of from 10 in. by 1 7/16 in. bars in each link of the chain.

These horizontal members were made up of three lengths of bars requiring two intermediate pins. At one of these pins the ends of the connecting bars were blocked and stiffened in order to limit their relative rotation about the pin, while at the other pin the bars were free to rotate.

In order to transfer the tension from the link plate between the top chords at *UO*, which had, up till this stage, resisted the tension due to continuity, a sheave block was hung from this pin and another was connected to the top chord of the anchor truss immediately underneath. A comparatively small pull (about 5 tons) on the whip line of a cable reeved through these blocks "toggled" the eye bars connecting at the pin and permitted the tie plates at *UO* to be disconnected. The holes at one end of these tie plates were slotted in the direction of the pull, so that by previously slackening slightly the bolts in these slotted holes the tie plates were free to slip backward towards the anchor span during the operation of toggling, thus preventing any resistance from them during that operation, and eliminating their removal. The removal of these ties eliminated ambiguity and ensured that all continuity was provided by the harness.

When erecting panel 8-10 a temporary subdiagonal *U*-8 *M*-9 was introduced to complete the triangulation in this panel for erection stresses.

When erection had reached *L*-10, i. e., one panel length short of the farther pier, it was provided that one-inch diameter guy lines be run in a diagonal direction by connecting one end to the east bottom lateral plate at L-10 and snubbing the other end around a hitching post, composed of a 6-in. diameter heavy duty pipe embedded in the copying at west side of bridge seat. A similar guy line to be attached to the lateral plate immediately opposite on the west truss and hitched around a similar snubbing post at the east side of the bridge seat. The *X* bracing thus formed was intended to hold the span against the wind pressure as well as the side sway due to the working of the derrick when erecting the last panel.

During the erection of the cantilever, additional counterweight was required on the anchor arm in order to resist uplift due to the overhanging deadweight combined with the overturning effect when the 90-ton derrick car was located at the outer tip of the overhang in the act of lowering a heavy member into place.

This uplift, in the case of spans 3 and 4, was counteracted by anchoring the end of the anchor span down

the dead and live load on the highway deck, which loads, of course, did not exist during erection.

The section of the angle bars comprising the lateral bracing was increased somewhat over what would be required for simple supported spans in order to provide lateral stiffness to resist wind stresses which might occur during erection, especially at the stage when the cantilever had almost reached the farther pier.

As previously stated, the first of the 280 ft. spans to be erected was assembled on falsework and served as the anchor arm for cantilevering span No. 2. This falsework consisted of timber towers 90 ft. high, spaced at 46-ft. centers and approximately under the panel points, each tower being composed of double frame bents braced as a unit and carried by a double row of piles capped about 10 ft. above the water level. The towers were built in three storys, each story being framed on the shore and lowered into place as a complete unit by the derrick car.

The elapsed time between driving the first pile for this falsework and completion of erection of the span was forty-six days. As the 276-ft. trestle approach was being erected at the same time pile driving was proceeding, the actual time occupied in erecting the trestle approach and the first truss span, including the falsework, was fifty days.

Figure 3 (*a*) to (*g*) shows, in sequence, the various steps in the erection of the first panel of the cantilevered spans.

The bottom chord members, *LO-L2* which were placed first and projected over 52 ft. beyond the pier, were temporarily tied back to the anchor span by plates connecting the top of their gusset (at *LO*) to the gusset on the lower chord of the anchor arm. At the same time compression blocks (or kickers) were placed in the space between the ends of the lower chords of the cantilever and the anchor span to transfer the thrust from the cantilever.

This was followed by the erection of end posts *LO-UO*, and the placing of six ⅞-in. diameter temporary tie rods of fifteen tons capacity at *MO*, also the introduction of temporary tie plates of 200 tons capacity connected gussets at top of these posts (point *UO*) to the top chords of the adjoining anchor span. After sub-diagonals *UO-M*1 were placed (see Fig. 3 (*e*)), the tie rods at *MO* were no longer necessary, also the tie plates at *LO*. The tie plates connecting the two spans together at *UO* were, however, required to take the tension during the erection of the first two main panels, after which the harness was erected and the tension in these ties was transferred to it.

to the span immediately behind it by means of tie rods connecting the gusset plate at the top of the end posts of the former to the gusset plate at the bottom of the end post of the latter. When erecting the last panel, additional anchorage was provided by placing another derrick car (or its equivalent weight) over the end panel of the anchor span. When cantilevering span No. 2, however, as its anchor span (No. 1) had no suitable span behind it, a kentledge of steel rails performed the duty of the tie rods previously mentioned.

In order to ensure that when the cantilever reached the farther pier the increasing deflection, due to the increasing overhang, would not bring the bottom chord of the last panel below the level of the bridge seat, the tie plates connecting the top chords of the cantilever at point *UO* to the anchor span had their connection holes so arranged that the first panel of the cantilever span was set with a tilt upward from the normal. As the span was built out, of course, the natural sag due to the overhang gradually nullified the effect of the upward tilt, so that by the time the last panel was erected the free end was about five inches below normal, but there was sufficient space between the shoe plate on the bottom chord and the bridge seat of the pier to permit the insertion of timber blocking. This end was then jacked up a sufficient height above normal to permit driving out the pins connecting the inclined tension members of the harness to the top chord of the cantilever. The continuity due to the harness being thus released, the span was then lowered on the jacks to its normal position on its pier members and thereatfer functioned as a "simple supported" span.

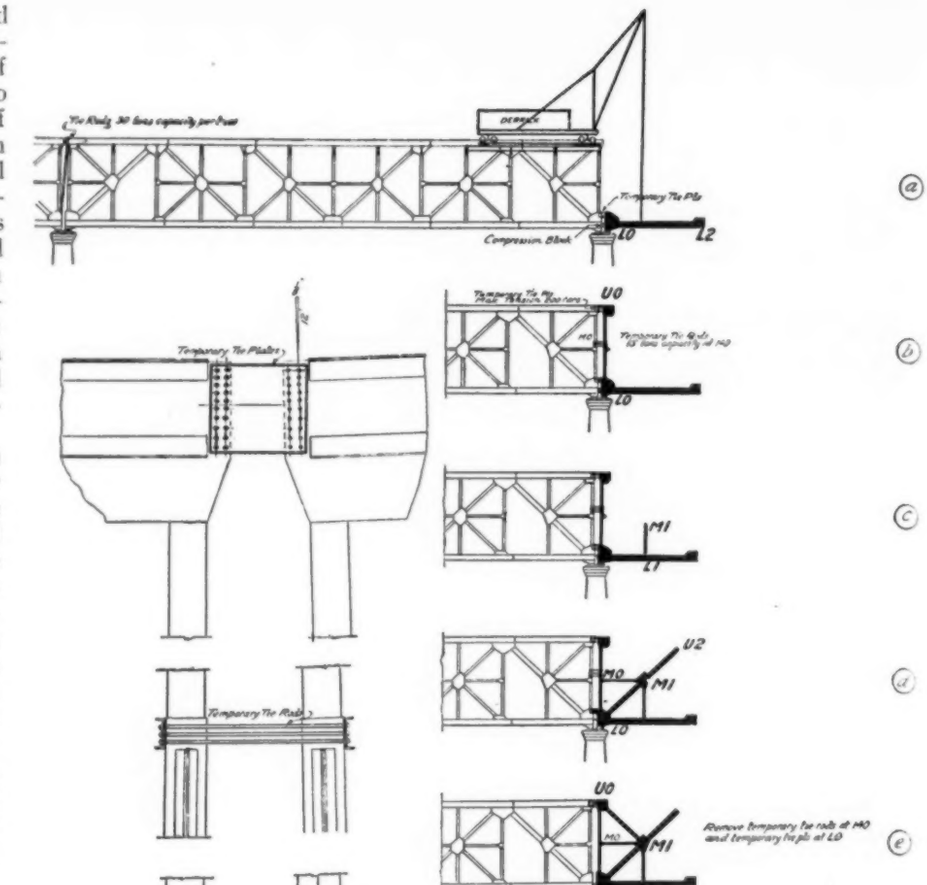

Fig. 3.—Sequence in Erection of First Panel of Cantilever Spans

As each member was erected, particular attention was given to connections. Definite and detailed instructions were issued to the field forces regarding the minimum number of bolts which must be inserted in the connection as each member was erected before adding additional weight to the cantilever. The erection drawings stipulated whether a member must be rivetted, fully bolted, or have a minimum of 75 per cent or 50 per cent bolts, depending upon the erection stress. These drawings also definitely outlined the sequence of the steps which the erectors were to follow in the process of assembling the cantilever span and the location of the front trucks of the derrick car while placing the various members.

The time required for erecting each of the cantilevered spans was 21 days. The writer wishes to emphasize the smoothness and expedition with which the erection work was carried out. Everything worked out in accordance with the preconceived plan and reflected the greatest credit on all members of the bridge company's personnel associated with the work.

Personnel.—The structure was designed, and the fabrication and erection of the superstructure supervised, by the bridge engineering staff of the Canadian Pacific Railway, J. M. R. Fairbairn, Chief Engineer, and P. B. Motley, Engineer of Bridges. The construction work in the field was under the direction of T. C. Macnabb, Engineer of Construction, Western Lines, with H. D. Brydone-Jack, Engineer at the side.

The Sydney E. Junkins Company, Ltd., Winnipeg, were contractors for the substructure. The Dominion Bridge Company, Ltd., were the contractors for the superstructure, which was fabricated in their Winnipeg plant. The erection work was carried out under the general direction of F. P. Sherwood, Chief Engineer of the bridge company, with H. M. White, Engineer, Winnipeg division in local charge.

EDITORIALS

Road Contracts to Be Widely Distributed

ONE of the rules governing the $400,000,000 federal road appropriation requires each state highway department to submit a road building program under which work shall be done "in at least 75 per cent of all counties of the state" unless satisfactory reasons can be given for restricting the work to fewer counties. The object of this rule is to provide employment in nearly every part of each state. This means an unusually large number of relatively small road contracts.

One of the consequences of such wide distribution of construction jobs will be the purchase of more road machinery than would be the case if the projects were fewer in number. But it should be remembered that any increase in the equipment purchased means increased employment by those engaged in making and selling the equipment.

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Credit "Jags" and the Business Cycle

UNLESS the fundamental causes of business depressions are correctly diagnosed, prevention of future depressions will never be possible. The most commonly assigned causes of the present depression are over-production of commodities and over-expansion of the instruments of production. Granting that these are among the contributing causes, is there not a cause of those causes?

The instruments of production are mainly land, buildings and machinery. While land cannot be increased, it can be put to use where formerly it was either entirely or partially idle, and its output can be increased by the use of machinery. Both of these methods have been employed by farmers, and with disastrous results to themselves. But what made it possible for the average farmer to increase his output inordinately? Credit. Insurance companies and banks vied with one another to furnish farmers with credit. Excessive expansion of farm output was the inevitable result under the existing economic system. Now that the government is enabling the farmer to secure credit and at lower interest rates, it is virtually pouring gasoline on the fire. But while thus augmenting the blaze by lowering interest rates, the government is trying to curb the flames by inducing farmers to reduce their cultivated acreage by paying them rentals on idle lands! Since this rental money will come from the consumers of farm products in the form of a "process tax," and since those consumers outnumber all the farmers by nearly four to one, it is easy to see how this "noble experiment" will end.

As the effect of excessive credit upon building, real estate booms all over America prior to the debacle of 1929 are witnesses. Those booms are financed mainly by loans secured by mortgages. And now most of the property investments thus financed are not worth the mortgages even on the allegedly conservative basis of 50 per cent of the former market value.

Factories were expanded rapidly during the last boom period, largely by the aid of borrowed money. Stocks were also sold to raise money for those expansions, but usually those sales were on the installment plan, which means more credit.

Every stock market boom is financed on credit, for buying on margin is a credit transaction.

In 1929 the total indebtedness of the American people is estimated to have been in excess of $300 billion, or $2,500 per capita, or nearly $10,000 per family. This indebtedness was fully 75 per cent of the value of all property in America, even at the high prices of 1929. During the preceding 40 years American per capita income had become three-fold, but per capita indebtedness to banks had become ten-fold, and other indebtedness had mounted even faster than that.

If credit were "the life of trade," America would have been entering upon its era of greatest prosperity in 1929. But credit is like certain drugs, a little of which is healthful stimulant, whereas more is deadly.

If excessive credit is the basic cause of booms, and its sudden curtailment is the main cause of panics, then we are a long way yet from a "planned economy" that will prevent or even mitigate future depressions. We are working out of this depression, much as we have worked out of previous depressions. Several years of prosperity are in sight. But unless control of credit becomes more effective, another boom will occur, and another debacle, all of which will be erroneously attributed to machinery and its diabolical habit of overproduction.

▼

Federal Rules Governing the Use of Machinery on Road Construction

THE National Industrial Recovery Act prescribes "that the maximum of human labor shall be used in lieu of machinery wherever practicable and consistent with sound economy and public advantage." A study of the federal rules that were printed on page 256 to 258 of our July issue shows that the aim has been to confine hand labor to those operations in which machinery is of least assistance. For example, the rules relative to grading and subgrading read: "All trimming of slopes in cuts and fills shall be done by hand labor methods. Ditches shall be trimmed by hand labor or team methods. All material windrowed between forms by the use of blade graders or subgrader planers shall be removed by hand labor methods." It will be seen that no restriction is placed upon the use of elevating or blade graders, power shovels, scrapers, or the like. In short, the rule as to grading complies with the law governing this work. Had the use of excavating machinery been prohibited, not only would it have been inconsistent with "sound public economy," but taxpayers would have come to regard the National Industrial Recovery Act as more worthy of being called an Act to Popularize Wastefulness.

There have been too many instances of "making public work" by absurd restrictions as to the use of machinery. It is refreshing, therefore, to have the federal government set a good example in this respect.

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The Economic Problem of the 30-Hour Week

UNDER the rules governing the $400,000,000 expenditures for federal road building, no man is to be permitted to work more than 30 hours a week. Since there is sun light enough to permit 13 or 14 hours of daylight operation during the summer, perhaps the most common practice will be the operation of two six-hour shifts with a half-hour intermission in each shift for

meals. This permits operating 5 days out of the 7, and leaves 2 days to be lost because of rainfall or for holiday purposes.

There are many possible combinations as to lengths of shifts and days per week, but the number of shifts must be one, two or three. Where two shifts are used, the 30-hour week may be secured by working two 8-hour shifts and two 7-hour shifts for two days each during the week. This plan leaves 3 days' leeway for bad weather layoffs, and is preferable to the two 6-hour shifts for 5 days where rainfall is frequent.

Where only one 10-hour shift is used, the letter of the law can be obeyed by working two gangs that work alternate days, or alternate pairs of days, or alternate trios of days. Thus one gang can work Monday, Tuesday and Wednesday, and the other gang can work Thursday, Friday and Saturday.

Where rains are infrequent it may be well to experiment with several different plans in order to find which plan is most acceptable to the workers. However, it should be remembered that experience in tunnel work has repeatedly shown that the greatest progress occurs when the shifts are short. Hence a 6-hour shift will probably be much more efficient than a 10-hour shift, and considerably more efficient than the combined 8-hour and 7-hour shifts above mentioned.

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Fifteen Years of Progress in Road Machinery

IN our July issue Mr. John H. Mullen summarized the progress in the use of road machinery from 1917 to 1932. He gave the following outputs per man-hour:

	1917	1922	1932
Grading, cu yds.	1.67	1.80	3.33
Paving, sq. yds.	0.90	1.03	1.70

These data were compiled by the Highway Research Board of the National Research Council. While this shows nearly 100 per cent increased output per man-hour during the last 15 years, Mr. Mullen emphasizes the fact that repairing and replacing road machinery reduces the apparent saving effected by its use. He cites Mr. J. L. Harrison's estimate that the cost of repairs and depreciation is 46 per cent of the amount expended for labor and road construction. And he adds that his own experience with "a completely motorized grading outfit" bears out Mr. Harrison's estimates.

Mr. Mullen says that in Minnesota contract prices for earth excavation and hauling averaged 31 cts. in 1922, and 19.6 cts. in 1931, in the face of the fact that the wages of common labor rose from 30 cts. an hour in 1922 to 45 cts. in 1931. Commenting on such decreases in contract prices, Mr. Mullen says:

"This decrease in the price of work should not be so great, and is not warranted, for it represents, in part, ignorance by the contractors of their depreciation expense. This is accounted for by the fact that the use of heavy equipment is so recent that contractors have not realized the cost of replacement, and, in the next year or two, will result in the elimination of many contractors and a partial return of prices. However, even taking into account proper allowance for equipment expense, the cost of work has greatly decreased.

"Secondly, we find that while the number of men per unit of work has decreased, the character of employment has been raised for the majority of employes from common labor to mechanical work with higher pay, and the decreased unit price for work has enabled enough more work to be done per dollar, even at a higher wage rate, to take care of a considerable portion of the decrease in field employment per unit.

"Third, and what is important to a state having manufacturing industries, the use of machinery on road work gives employment to about half as many people in the machinery business as are employed on the job. So that on the whole the displacement of man power by the machine on road work has been a benefit to labor, as well as providing the speed and efficiency which this age demands."

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"Back to the Farm?"

THE late James J. Hill, president of the Great Northern Railway, was an outstanding "back to the farm" propagandist. He lived a long life, but during that life American farm population became a very much smaller percentage of the total. Each major business depression halted the trek away from the farm and led to a slight flow of population toward the country. However, the "back to the farm" flow was always brief. The reason for its brevity was this: Inventiveness and scientific discovery constantly increase the productivity of the average American farmer faster than our population increases; and since the total consumption of food is directly proportional to the population, it follows that a progressively smaller percentage of farmers is needed to supply the food. There is, of course, an increasing consumption of more expensive kinds of foods, and this retards the exodus from the farms to some extent. There is also the reluctance of many farm-bred men to live in cities. But such factors merely retard the movement of population toward the cities. That movement will as surely continue during the next century as it has continued during the past century, although at a less rapid rate.

At the time of the War of the Revolution, 90 per cent of our population was agricultural. In 1930 the percentage was 25. A few years ago Burbank, "the plant wizard," said that if every farmer used the best machinery, methods and seed, the output of the average farm could be doubled without appreciable increase in cost. It follows that right now our farms could produce all that is being produced even if half the farmers were to move to the cities.

In view of such facts the President's Tennessee Valley Project seems to be foredoomed to economic failure.

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Why Not Hang Edison in Effigy?

Westbrook Pegler of the Chicago Tribune says:

"It looks as if the new deal in American industry will offer a fine opportunity for a new kind of industrial expert who might be called the inefficiency man. From my reading of the hearings which are being conducted in Washington by Brig. Gen. Hugh S. Johnson, in connection with the fifteen minute plan for industrial recovery, I gather that the fine old American ideal of efficiency has been renounced along with the fine old American virtues of thrift, economy, industry and sobriety. . . .

"The boys could outlaw the steam roller and compel the work to be done by hand and the lineotype could be made illegal, like the submachine gun, as detrimental to the general good of the greatest number.

"But the first aim of the inefficiency man should be to arouse public opinion against a lot of false gods of the industrial era. I hope I am not presumptuous when I suggest that Gen. Johnson organize a great national hanging in effigy of Eli Whitney and Mergenthaler and Thomas A. Edison and the burning of the patent office."

W. P. Gillette

County and Township Roads

A Section Devoted to the Interests of Those Responsible for Secondary Road Improvement

How Pennsylvania Is Solving the Farm-to-Market Road Problem

By SAMUEL S. LEWIS

Secretary, Pennsylvania Department of Highways

PENNSYLVANIA is engaged in a program which has as its chief objective the further development of the state highway system through a wider extension of rural road improvement.

Adopting a type of construction low enough in cost immediately to extend the benefits of good roads over the widest possible area, and at the same time substantial enough to carry normal rural traffic, Pennsylvania's farm-to-market highways are accomplishing a four-fold blessing: They are rapidly taking the farmer out of the mud; they are opening up a wide rural territory to urban markets; they are greatly reducing the burden of taxation; they almost providentially have brought work-relief in this period of extensive unemployment.

While the Pennsylvania Department of Highways was created in 1903, the first transfer of roads from local authorities to the Department of Highways, did not occur until 1911, when approximately 8,000 miles came under the jurisdiction of the state. Subsequent legislatures transferred additional mileage until, on Jan. 20, 1931, at the beginning of the present Pinchot administration, there were 13,640 miles on the Pennsylvania State Highway System. Of this total 10,526 miles had been improved.

20,000 Miles of Rural Roads Added to State System.—In his candidacy Governor Pinchot pledged himself to take the farmer out of the mud by adding 20,000 miles of rural roads to the state highway system. Through legislation he accomplished the taking over of 20,205 miles of rural roads that had been under township control, the amount representing about 25 per cent of all of the roads then maintained by township supervisors. There were also added about 300 miles of city streets. The state highway system was thus increased to 34,145 miles.

From Jan. 20, 1931, to Nov. 15, 1932, there were constructed under the Pinchot administration 6,643 miles of highways, or in 22 months more than three-fifths as many miles of roads as in all of the preceding twenty-two years.

In Pennsylvania, costs of construction and maintenance of state highways, and of administration of the department, are paid from the motor funds, the chief sources of which are motor vehicle license fees, operators' license fees, and gasoline tax. Thus far it has been found possible to finance our vast program of state highway construction and maintenance without seeking any additional sources of revenue.

From Aug. 15, 1931—at which time the 20,205 miles of rural roads were transferred to the state highway system under the Pinchot plan—to Nov. 15, 1932, 4,900 miles of these roads had been hard-surfaced at an average cost of approximately $6,000 per mile. On all of the remaining miles of these rural roads taken over by the state, every one has been brushed, widened, and drained pending further improvement.

Transfer of Roads from Township Makes Saving.—The transfer of responsibility for improvement and maintenance of these roads from our small political subdivisions, known as townships, to the state as a whole, already has accomplished an annual direct saving of about $2,500,000 in local taxation. Those townships which did not reduce their road tax as a result of transfer of a portion of their roads to the state have available about one-third more money to apply to the improvement of their remaining road mileage without increasing taxation.

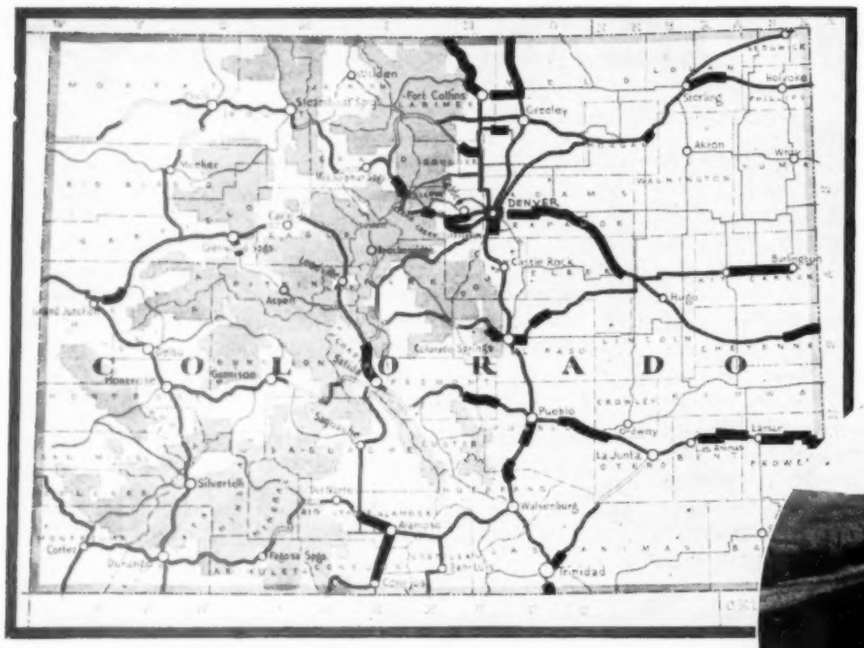
Although the present extent of unemployment was not anticipated when Governor Pinchot's rural road program was projected, our highway operations already have afforded more work-relief than could have been provided in any other way. It has been found possible to apply much hand labor to which all classes of unemployed are adaptable. As many as 48,419 laborers have been engaged on the state highways in Pennsylvania during one month under this program. This is exclusive of the department's salaried employes. As we estimate four dependents as the average of every worker, 250,000 persons were sharing the benefit. In fact the Department of Highways is the biggest single employer of labor in Pennsylvania today.

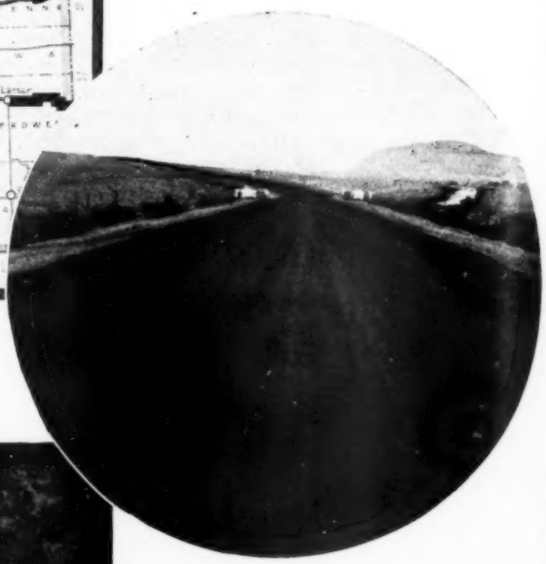
To accomplish this achievement in road building, it was necessary to simplify engineering and, to some extent, to strike boldly away from the beaten track of the usual methods of highway construction.

Although our project in the beginning was experimental, and many were the predictions of failure, we have proceeded far enough to establish the soundness of the undertaking. To have waited for high-cost roads would have left the rural dweller isolated for many years to come. No state could have undertaken so extensive a program of high-cost construction. No township or county could have accomplished it by taxation. Many of our townships are so sparsely populated that their road revenues are sufficient only for the most vital maintenance.

Survey and inspection expense on low-cost construction has been practically eliminated because projects are placed under the supervision of qualified employes who are familiar with common engineering practices. The

Colorado Highway is Constructing an System . . .





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policy pursued in our low-cost improvement is to perform the necessary rough grading. This grading is carried on by means of power graders, steam shovels, tractor drawn graders, and other suitable equipment. The necessary drainage is then taken care of, especially drainage pipes and small bridges. Before proceeding to place the base, particular attention is paid to throwing up ample shoulders.

Base Construction.—There being a large variety of soils throughout Pennsylvania varying from mica silt, clay loams and sandy loams, to sand, gravel and shale, the depth of foundation for the finished surface will vary throughout the state. In some cases, the base and wearing surface are constructed as one course. The base on a large majority of our mileage is of native stone napped in place. This stone must withstand rolling and must not disintegrate under extreme variations in temperature. It is to be found along our highways, in the fields, on the mountain sides, in the valleys adjacent to streams, and in some cases is blasted from rock faces adjacent to our highways. One of our principal sources of supply of this material is to be found in fence rows and in piles of stones in fields thrown up years ago by pioneer settlers clearing the land. In some cases where native stone of the above variety is not available, there may be found deposits of gravel, flint and shale. We have also taken advantage of crushed and granulated slag, cinders, and "red dog," which, as you probably know, is the result of the incineration of coal culm banks. Where materials are used other than native stone napped in place, grading is not stipulated for flint or "red dog," as they naturally are of smaller sizes. On run-of-bank gravel, run-of-crusher slag, or commercial run-of-crusher stone, it is specificed that this material shall pass a 4-in. circular opening with not more than 15 per cent passing a 1¼-in. circular opening. In the case of run-of-bank gravel, where an excess of large size is apparent, the maximum size is further reduced. These materials are spread on the finished subgrade by means of spreader boxes attached to trucks.

The voids in the napped stone base are filled by additional smaller fragments of stone or by the addition of fine gravel, crushed or granulated slag or cinders, and in a few cases where these materials are not available, clay.

All bases are thoroughly rolled and compacted by means of a power roller.

The Surface.—The surface on these roads is either an oilbound macadam wearing surface, heavy surface treatment, or so-called retread mixed in place. I call your attention particularly to the oilbound macadam surface course. This type developed by the Pennsylvania Department of Highways has been used extensively in the construction of low-cost highways. A specified grading of ¾ in. commercial stone is spread so that a 2-in. compressed depth is obtained. After the stone has been thoroughly rolled, from ¾ to 1 gal. per square yard of bituminous material is applied in two applications. After the surface has been dragged and rolled to a uniform cross-section and allowed to dry from 24 to 36 hours, a third application, or seal coat, is applied at the rate of ¼ gal. per square yard after which there is spread uniformly over the finished surface ½ in. commercial size stone at the rate of approximately 20 lb. per square yard. This is again rolled until the surface is thoroughly compacted and the project is ready to be thrown open to traffic. Under certain favorable conditions, the native stone base is given only a heavy surface treatment which consists of commercial stone of a specified grading and an application of bituminous material varying from .7 to 1 gal, per square yard.

Where retreads are used for the finished surface, the mixed-in-place method has been adopted, as we believe it to be most economical under conditions existing in our state. We have, however, been experimenting with a pre-coated material, the result of which we are looking forward to with a great deal of interest.

There are, of course, a large number of variations from the standard of established practices. These are made necessary by reason of the many classes of materials, soil conditions, cost of materials, grading of the aggregates as found in native conditions, as well as the presence of water, and in some cases are controlled by the shape of trees constantly covering sections of the highways.

$2,311,000 *Spent for Equipment Purchases.*—The task of improving farm-to-market roads, being undertaken by department forces, made it necessary for us to purchase a sufficient amount of equipment and machinery to guarantee against loss due to delays and assure economic handling of this work. During 1931 and 1932 we purchased equipment valued at $2,311,000. This equipment includes tractors, rollers, power graders, drawn graders, tractor graders, power shovels and other suitable road-building equipment.

More than 1,250,000 ft. of culvert pipe were laid during the year 1932 for the purpose of drainage. We used 35,000,000 gal. of bituminous materials between Jan. 1 and Nov. 1, 1932. We shall continue to use large quantities of the materials in our development of construction and in the annual surface treatments which are an essential factor in maintenance of improved rural roads.

Safety Details.—Details of safety receive attention on our rural roads just as they do on the more costly highways. Frequently we resort to relocation to eliminate hazards and add to convenience. Horizontal and vertical curves are reduced where possible. Super-elevation of curves and flaring of intersections are other important safety considerations. Guard rails are installed wherever conditions require.

Warning and informative signs are maintained on our entire highway system. A new and advanced standardization of signs in which symbols play the most important part has been adopted in Pennsylvania to assist the motorist in guarding against traffic accidents.

Acknowledgment.—The foregoing is an abstract of a paper presented at the 10th annual Asphalt Paving Conference.

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HIGHWAYS IN BULGARIA.—Constructed highways in Bulgaria, as of March 31, 1932, totaled 10,652 miles, of which 310 were completed during the budgetary year 1932/32 (April-March). There remain about 4,532 miles of new highways to be completed. The expenditures for the 1931-32 fiscal year approximated $3,513,600 both in money and compulsory labor. The allotments in the 1932/33 budget for construction of highways, bridges and maintenance approximate $3,223,000, divided as follows: From the budget—construction of new highways and bridges, $57,550; maintenance of old highways and bridges, $230,210; from the Municipal Road funds, $705,030; construction and maintenance by Municipal Compulsory Road Service (converted into money), $1,151,075; and by State Compulsory Labor, $1,079,135.

A Mixed-in Place Construction Job In Michigan

AN interesting "mixed-in-place" retread job has been in progress in northeastern Michigan—interesting because of the rapid, thorough mix and the uniform spread of material to specifications obtained through the use of a new special machine designed for this work. The road is a stretch of Michigan State Highway No. 29 in Huron County, running 5.8 miles east out of Port Austin. The contractor is Middle West

Fig. 1—Paver Spreading Stone to Desired Width and Depth Before Applying Bitumen

Roads Co. of Flint, Mich., a subsidiary of Warren Brothers.

The old road was a rough stretch of 16 ft. macadam laid about nine years ago. The first step in improvement was to increase the road surface to 20 ft. by laying a 2 ft. base strip of 4 in. stone on either side of the old pavement. These courses received a penetration shot of cut-back asphalt. The old road being bituminous bound, no prime coat was used on the old surface.

A sufficient amount of crushed stone was dumped on the roadway to spread to 165 lb. per square yard. This stone, grading 1½ in. and smaller, was spread roughly by a motor grader and was then leveled out to uniform depth and width by the mixing machine, which was an

Fig. 2—First Application of Bitumen at the Rate of ½ gal. per Yard

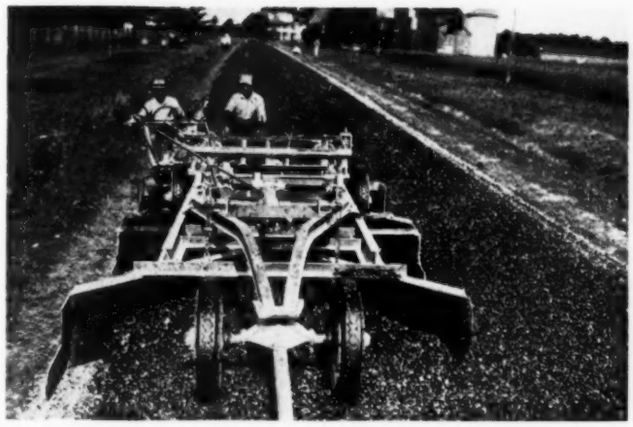

Fig. 3—Adams Retread Paver Mixing the Aggregate Four Times in One Trip

Adams Retread Paver No. 2. For the purpose of keeping the stone well within the finishing line for mixing, the width was held to approximately 18 ft., at which width the stone bulked about 3 in. deep.

The bitumen used was a cut-back asphalt which was put on in three applications. The first application was ½ gal. per square yard. Following this application the Adams Retread Paver accomplished a thorough mix in three round trips. The second application was 3/10 gal. per square yard, after which the aggregate was again mixed by two round trips of the paver. Following the last mix a final trip was made with the paver, which spread the material to proper crown and to a uniform width of 20 ft. with clean-cut, straight edges. After the asphalt had set properly, the surface was rolled and compacted to a depth of about 2 in. The rolling operation was followed by the third application of asphalt at the

Fig. 4—The Finishing Round with the Paver—Material Spread to Specifications

rate of ¼ gal. per yard and the application of stone chips which were rolled into the voids. The work was under the direct supervision of a Michigan State Highway Department inspector. There was every indication that the number of mixes after the first application of bitumen could be reduced from three to two.

The paver used on this job has three sets of mixing blades and an independently controlled rear leveling or spreading blade; one trip with this machine is equivalent to four trips with a motor grader or other single blade

machine. The claim is made that this not only speeds up the work and reduces mixing costs but, particularly with bitumen which sets up comparatively rapidly, a better mix is obtained because the mixing is accomplished while the bitumen is in its most liquid state.

For durability a thorough and uniform mix on this type of road is always essential, but of no less importance to the ultimate user is the final distribution, which results in a smooth desirable driving surface or a wavy undesirable surface; here the special machine showed its greatest value. The paver has an independently oper-

Fig. 5—Rolling Operation Which Follows the Paver. Water Barrels Mounted on the Rollers Feed Water to Burlap Sacks Which Drag the Roller Faces Keeping Them Wet So That Rollers Will Not Pick Up Bitumen

ated rear leveling blade which is controlled by the operator at the center of the machine as shown in Fig. 4. During the mixing operations, this blade is lowered sufficiently to get just a rough spread of the material, but on the final round it is set to get the exact specifications required. First, it is set to get the desired crown, 4 in. in this case, and to hold this adjustment the operator is guided by a spirit level in front of him. Next the right hand end of the blade is extended inward or outward to get the width spread desired. The leveling blade is set to spread the material to the proper depth or thickness and the mixing blades are set just low enough to feed material to this blade for the filling of any low places. The finished spread rolls out from underneath the blade like a huge black ribbon—smooth, free from the irregularities in the old road surface and ready to roll. The right hand operator shown in Fig. 4 has two duties—first, to raise and lower the mixing blades and second to steer the rear end of the machine. The purpose of the independent rear end steering is to enable the operator to hold to a straight line in the finishing round, so that it is not affected by any careless driving on the part of the tractor operator. Another function is to hold the machine up on an elevated curve, so that the material can be spread properly.

The paver has demonstrated a capacity to complete one mile of road per day, if the supply of material, distributors, and rolling equipment are organized to keep up with the paver.

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WHY CONTRACTORS GET BALD HEADED.—According to the Dixie Contractor:

The specifications called for the concrete to be thoroughly sprinkled each day for seven days. A sudden rain came up about noon and made the subgrade too wet to haul over and the mixer was shut down. The entire crew was leaving the job in a truck when the inspector halted them with the demand that two men be left to sprinkle "yesterday's pour."

Widening Old Timber Bridges Under Traffic

A RATHER unusual method was used to widen some old timber bridges on U. S. Highway 75 between Madisonville and Huntsville, Tex., to adapt these structures to main line highway service. The bridges were built about 12 years ago when this section of the road was not part of an important through highway, and had only a 16-ft. roadway. How these bridges were widened without interrupting traffic is told in the May issue of *Wood Preserving News,* by John E. Blair, Division Engineer, Texas State Highway Department.

The bents were of four piles each, the caps 10 by 12 in. by 18 ft. long; the stringers, of 4 by 12-in. lumber; and the panels, 19-ft. span. All lumber was pressure treated with 12 lb. of creosote per foot, with the exception of the floor, which was of untreated pine, 3 by 8 in. laid flat.

Eight bridges were involved, these varying from two to twenty panels in length, the total length of all the bridges being practically 1,000 ft.

Since these bridges were built, this highway has been paved throughout its length from Dallas to Houston, and traffic has increased enormously. Consideration was given to the matter of replacing these old structures with new ones, but after some discussion it was decided to salvage them by widening. The determining factor was the fact that there was no other crossing of this creek available, and, therefore, no possibility of providing a detour.

Because it was necessary to maintain uninterrupted traffic, it was not considered practicable to drive additional piles and to provide new and longer caps, which would have been the logical plan under different circumstances. After considerable study of the problem, it was concluded that the only way all the difficulties could be met was by splicing extensions on the old caps, putting on sway braces, which had been omitted in the original construction, adding extra stringers, laying a new 4-in. floor of creosoted lumber, and placing an asphaltic wearing course. All this was to be done without stopping traffic, a considerable part of which consisted of heavy trucks.

As the first step, the ends of the old caps were cut square, this usually involving the cutting off of about an inch or two at each end. New sections of cap, each 3 ft. long, were then spliced onto each end of the old piece. To make the splice, a piece of 4 by 12-in. lumber 4 ft. long was placed each side and bolted through the old cap with six 1-in. bolts, three each side of the splice. The outer end of the short piece spliced on was supported by sway braces from the piles, one brace being placed each side and bolted through the end of the cap. In order to take part of the strain on the single bolt which fastened the sway braces to each pile, a block was placed between the two sway braces against the outside pile, this block being bolted to the sway braces and notched slightly into the pile. All new cuts of the timber were painted with hot creosote and covered with hot asphalt. Cast ogee washers were used on all bolts.

After all the caps had been extended, two new lines of 4 by 12-in. stringers were placed at each side in each panel, all this having been done without any disturbance to traffic. The bridge was now ready for the new floor.

The old hand rail and felloe guard were removed from one panel of the bridge, and one of the old 3 by 8-in. floor plank at a time was pried off and dropped to the ground. The exposed tops of the old stringers were

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If you are going to bid on any bituminous road work, be sure to get full particulars on the Littleford line of equipment—it is designed for construction and maintenance of bituminous roads. It includes Pressure Distributors, Supply Tanks, Tar and Asphalt Kettles, Surface Heaters, and many other outfits essential to efficient work on secondary highways.

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LITTLEFORD

Road Maintenance Equipment

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cleaned off and heavily brushed with creosote, and new 2 by 4-in. floor plank, 22 ft. long and set on edge, were placed to fill the space where the plank had been taken out. By never taking out more than one or two of the old plank at a time, it was possible to pass traffic at any instant. The new floor planks were nailed to one another, and at intervals were toenailed to the stringers. The most tedious part of the whole proceeding was the handling of the new floor plank, the 22-ft. lengths proving to be rather awkward to handle under the conditions under which the work had to be done. Most of the bridges were so high that the planks could not be handed up endways from the ground, but had to be stacked on the bridge and put into place from there. Considering the interference due to traffic, the work went fairly smoothly.

Asphalt wearing course was placed later, under contract by the contractor on another project.

All the timber work was done by state forces on a day labor basis, being handled by the regular maintenance organization of the Texas Highway Department.

Part of the work done consisted of driving new piles to replace one bent which had washed out, these piles being driven through the floor of the bridge, and the load transferred without stopping traffic. It was also necessary to drive several extra piles in connection with widening some of the timber bulkheads.

The cost of the above described work, including all labor of installation, was as follows:

412 lin. ft. new creosoted piles driven	$ 377.80
130.741 ft. creosoted lumber placed	9,841.60
Bolts and other hardware	556.01
Total	$10,775.41

The work was planned and carried out under the direction of John E. Blair, as Division Engineer, and Ed Bluestein, Assistant Division Engineer, directly in charge of the work.

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Sheets Now Consulting Engineer for Portland Cement Association

Frank T. Sheets, until recently chief highway engineer of Illinois, who for the past twelve years has directed the building of the state's 11,000-mile hard road system, has been appointed consulting engineer of the Portland Cement Association.

Mr. Sheets is recognized as one of the foremost road authorities. Principles of concrete pavement design developed by him or under his direction are in wide use in the United States and in many foreign countries.

He entered highway service in Illinois in 1907 and served continuously until last January, except for time spent as a student at the University of Illinois. Through competitive civil service examintions he rose through the ranks from junior engineer, until in 1921 he was appointed state superintendent of highways. In 1924 he also became chief highway engineer and thereafter served in a dual capacity.

Direction of Illinois' amazing highway program was assumed by Mr. Sheets shortly after the program was adopted. Under his leadership, some 11,000 miles of road, largely hard surfaced, were built. In 1924 he established an unbeaten record in pavement construction when 1,230 miles of concrete were laid.

Bridge Maintenance Costs

The notes following are abstracted from a paper "Low Cost Bridges," presented by Searcy B. Slack, Bridge Engineer, State Highway Board of Georgia, at the 19th annual highway conference at the University of Michigan.

The maintenance costs vary widely with the different types of construction. Unfortunately, available data on many of the materials and combinations of materials are very meager.

Perhaps the best data available on maintenance relate to structural steel. The principal item in the maintenance of steel is the cost of cleaning and painting. There are a few other items, such as replacing rivets which work loose, tightening nuts, replacing or adjusting expansion plates, but the cost of these items is very small and is generally included under painting. The cost of painting varies widely, depending upon the detail of the bridge and the exposure. Average figures should not be used without consideration of the exposure. F. H. Frankland, Director of Engineering Service of the American Institute of Steel Construction, estimates the cost of painting to be $1.00 per ton per year.

Mr. McCullough gives the following information for various conditions in Oregon:

Unit Costs for Maintenance Painting Steel Highway Bridges, Oregon

Bridge No.	Costs per Ton per Year Labor	Material	Equipment	Total	Remarks
1	1.36	1.39	0.64	3.39	1 coat
2	1.66	1.12	0.75	3.53	1 coat
3	1.90	1.05	0.50	3.45	1 coat
4	5.22	1.54	1.84	8.60	2 coats
5	3.95	0.91	0.41	5.27	1 coat
6	5.35	1.80	2.25	9.40	2 coats plus cleaning
7	7.28	1.40	2.12	10.80	2 coats plus cleaning
8	2.05	0.50	1.05	3.60	1 coat
9	5.50	1.50	1.65	8.65	1 coat
10	5.50	0.60	0.62	6.72	1 coat
11	1.45	0.55	0.32	2.32	1 coat
12	1.65	0.42	0.15	2.22	1 coat
13	5.58	2.25	2.00	9.80	1 coat
14	5.70	3.50	1.75	10.95	1 coat
15	18.70	2.75	3.25	24.70	2 coats plus cleaning
16	6 88	2.09	1.58	10.55	2 coats plus spotting

The cost of maintenance painting on structural steel on the highway bridges in Georgia is as follows:

Unit Costs for Maintenance Painting Steel Highway Bridges, Georgia

Bridge No.	Cost per Ton per Year Materials	Labor	Incidentals	Total	Remarks
1	.48	.72	.14	1.34	Cleaned, wire brushes 1 coat red lead 1 coat aluminum
2	.46	1.04	.18	1.68	Cleaned, wire brushes 1 coat red lead 1 coat aluminum 2640′ extra pipe handrail
3	.43	.81	.16	1.40	Cleaned, wire brushes 1 coat red lead 1 coat aluminum Bottom partial
4	.39	1.41	.38	2.18	Cleaned, sand blast 1 coat red lead 1 coat aluminum
5	.74	.63	.68	2.05	Cleaned, sand blast 1 coat red lead 1 coat aluminum Bottom partial
6	.41	.85	.34	1.60	Cleaned, sand blast 1 coat red lead 1 coat aluminum Bottom partial
7	.72	2.06	.64	3.42	Cleaned, sand blast 1 coat red lead 1 coat aluminum Bottom partial
8	.59	1.76	.57	2.92	Cleaned, sand blast 1 coat red lead 1 coat aluminum Bottom partial
9	.39	1.13	.29	1.81	Cleaned, sand blast 1 coat red lead 1 coat aluminum Bottom partial
10	.33	1.21	.22	1.76	Cleaned, wire brushes 1 coat red lead 1 coat aluminum Bottom partial

The maintenance on concrete structures consists of repairs to guard rail, patching over steel placed too near the surface, repairing expansion joints, and other minor items. The annual maintenance cost has been estimated to be 0.5 per cent of the first cost of the structure. With great care in working out details of design, selection of materials, and construction, this repair work can be reduced, but such perfection in construction is difficult to obtain when a large number of structures are considered.

The maintenance cost on creosoted timber structures varies widely with the different types of construction. J. F. Seiler, service engineer of the American Wood Preservers' Association, estimates the annual maintenance cost on creosoted timber structures to be 1.5 per cent of the first cost. Mr. Seiler's estimate is based largely on information secured from railroad engineers, and he states that good maintenance information is meager, especially on highway bridges. When account is taken of replacing material which decays due to improper treatment, careless handling, cutting after treatment, and other factors which, while not properly chargeable to this material, are of common occurrence, Mr. Seiler's estimate is probably low. Mr. McCollough estimates this charge to be about 3 per cent, which seems to be a fair estimate.

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HIGHWAYS OF AUSTRIA.—There are 37,920 miles of roads in Austria, divided as follows: 2,510 miles administered by the National Government; and 35,510 miles administered by the provinces, cities, and communes. The area of Austria is 32,377 square miles and the population, 6,694,152 (1929 estimate) with 51 per cent rural. In 1929 the population of Vienna was 1,865,780; Graz, 152,706; Linz, 108,081; and Innsbruck, 56,401. On January 1, 1933, motor vehicle registrations totaled 34,458, divided as follows: Passenger cars, 17,738; busses, 2,037; and trucks, 14,638. There were also 37,776 motorcycles registered.

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LIMITED WAY ONE MILE LONG WOULD SAVE $342,187.50.—One mile of Limited Way—through elevated or depressed highway—would save motorists more than $300,000 a year, if 50,000 cars passed over the artery each day, according to Dr. Miller McClintock, director of the Albert Russel Erskin Traffic Bureau at Harvard University. The statement is found in a recent report by the Bureau on Chicago's traffic situation. "The daily time saving of a given mile of Limited Way carrying 50,000 cars is 75,000 vehicle minutes," said Dr. McClintock. "Computed at the rate of 1.25 cents per minute, this means a daily saving of $937.50. Thus in a year we see that the motorists using the Limited Way are saved $342,187.50—a lot of money."

New Equipment and Materials

New Bituminous Distributor

An improved series of bituminous distributors for mounting on a light truck chassis, such as a Ford or Chevrolet, has just been announced by The Austin-Western Road Machinery Co., Chicago.

In the design of this Junior line, offering capacities of 400, 500, and 600 gals., all the desirable features of the Austin larger units have been maintained. For example: pump, piping, and valves are enclosed in insulated heat chambers; a water-cooled engine is used to drive the pump in place of the air-cooled power unit frequently found in small

Austin Junior Bituminous Distributor

distributors; the pump is provided with a cored jacket, through which the exhaust from the power unit is piped; and the exhaust is also piped to the rear, where it is used for heating and blowing out the spray system.

The power unit is located in front of the tank, as in all Austin distributors. The pump and all other parts are placed so as not to hang below the truck chassis frame. Thus the distributor may be mounted on any truck without special alterations, and the truck may be used with dump or other body when the distributor is not needed.

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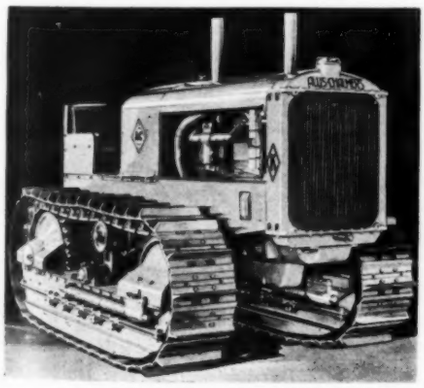
New A-C Tractor

A new track-type tractor, the Model "K," has been announced by the Allis-Chalmers Manufacturing Co., Milwaukee, Wis. The new model develops a maximum of 48 drawbar horsepower and has a top speed of 4.5 miles per hour. At 2.08 miles an hour it is stated to develop 8,750 drawbar pounds pull. The 15-in. track shoes give a total of 2,010 sq. in. of track surface in contact with the ground, providing ample traction to hold the extra power. The "K" weighs approximately 11,000 lbs., giving a ground pressure per square inch of 5.27 lb.

In addition to the new power and speed, the drawbar has been specifically designed to stand the heavy blows of a direct hitch 7 or 8 yard wagon. This drawbar also has a wide swing which materially lessens the side draft when pulling a blade grader. The engine is equipped with inserted valve seats which have proven very dependable and economical. These exhaust seats are made of special steel which has a very high resistance to heat, and not only is better efficiency obtained from the engine, but valve grindings are reduced to a minimum.

The general dimensions are: Tread, 48 in.; height, top tank of radiator, 64 in.; overall width, 65⅞ in.; overall length. 119 9/16 in.; ground contact, center drive sprocket to center of track idler, 67 in.; height of drawbar hitch, 16½ in.; clearance, 12¼ in. The engine is a 4-cylinder A-C design and make; bore, 5 in.; stroke, 6½ in., 1,050 r.p.m.



Allis-Chalmers Model K

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New Pneumatic-Tired Enclosed-Gear Mower

The McCormick-Deering enclosed gear mower recently developed by the International Harvester Co., Chicago, Ill., has been very favorably received by farmers everywhere. This is the new mower that has incorporated in its design and construction certain automotive principles. It operates with notable smoothness and lack of noise.

This new No. 7 enclosed gear, as it is called, may now be provided with balloon-type rubber-tired wheels for mowing shoulders along hard-surfaced highways. In addition to use along highways, the pneumatic-tired mower may be employed in fields where special crops or adverse conditions make the use of ordinary mower wheels equipped with lugs inadvisable. The pneumatic tires provide greater traction and make riding easier than the old-style hard-rubber tires formerly used on highway mowers.

New Pneumatic Tired Mower for Mowing Along Road Shoulders

The balloon tires are 5.25x21 in size, fit over conventional automobile-type rims, and are secured by locking lugs attached to each spoke. This makes removal of the tires as simple as on an automobile. Each wheel is provided with a special split hub which makes it easy to slip the wheel on to the axle shaft. After being put in place, the wheel is clamped tightly around the axle by four bolts through the hub. The wheel is also keyed to the axle.

The ratchets of the enclosed-gear mower are inside a gear box filled with oil. The main axle, to which the wheels are solidly keyed, is made in two sections, and these are connected by a differential arrangement inside the gear box. With the wheels keyed directly to the axle, end play and wabbling are eliminated.

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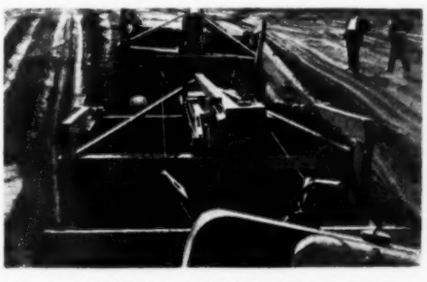
Power Unit for Handling Large Scrapers

Handling two cable-controlled 11-yd. scrapers behind a single tractor, both scrapers operated by the tractor operator, is made possible by a new four drum power control just placed on the market by R. G. Le Tourneau, Inc., of Stockton, Calif.

The control unit is handled by means of levers. One lever controls each drum; thrown into one position it engages a clutch and causes the drum to wind up the cable, thrown into the opposite position, it releases the drum and allows the cable to run out; when the lever is released an automatic brake locks the drum into position.

Two drums are used for each scraper,



Control Unit for Handling Two Scrapers

one to lower the scraper bowl for loading and raise it for hauling, the other to operate the unloading gate. No change is necessary in the scrapers used with the four drum power control unit other than the addition of sheaves for the cables and a connecting hitch between them.

New Blast Hole and Prospecting Drill

All steel construction, full crawler mounting, chain drive throughout, dual spring shock absorbers for wire drilling—these are the four most outstanding new mechanical features of a drilling machine recently brought out by the Keystone Driller Co., Beaver Falls, Pa.

The machine is extremely compact and sturdy, and over half of its weight is concentrated in the crawler assembly, giving a very low center of gravity and great stability on steep hillsides. It is claimed to be the first and only complete all-steel crawler mounted drill made especially for drilling holes 6 in. or smaller in diameter, at the lowest cost per foot drilled.

The machine may be used for drilling larger holes, but maximum economy is attained in drilling 6-in. holes. It will drill to a depth of 900 ft. and is especially suitable for blast hole drilling in limestone and sandstone, where the 6-in. hole is usually the largest which can be economically used. It is also intended to fit the requirements of most open pit coal, iron, copper, and other mining operations, including zinc, lead, and placer gold testing and prospecting in general.

All high speed parts run on large ball and roller bearings. A unique feature is a simple system of power transmission by silent, efficient, sturdy roller chains, which eliminates slippage and reduces bearing loads greatly as compared with belt drive. Chains also contribute greatly towards compactness, both as to width and length, making possible a machine weighing only 14,000 lbs., yet in strength and drilling capacity comparing favorably with older types of drilling machines weighing twice as much.

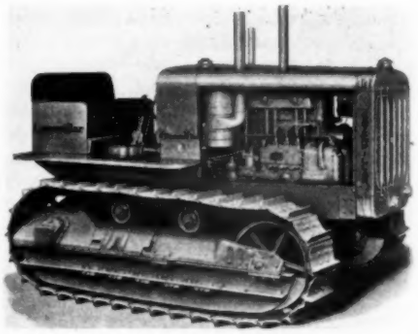
One of these machines was recently shipped by steamer to New Guinea, whence it was transported by airplane to the gold fields in the interior, operated by the Bulolo Gold Dredging Company, whose operations in the tropical fastnesses of a country inhabited by treacherous savages, were the subject of a recent story in the Saturday Evening Post. Another machine is drilling trap rock in an eastern quarry; one was shipped to Dawson, Yucon Territory, where it made a 100-mile trek on its own crawlers through ice and snow to the placer gold fields of Alaska; and yet another is drilling rock on a highway project for a firm of successful contractors.

New Keystone Blast Hole and Prospecting Drill

"Caterpillar" Announces the Diesel Thirty-five

Although the Diesel Thirty-Five tractor, just announced by Caterpillar Tractor Co. of Peoria, Ill., contains many interesting features, it is really new in name only, since it brings the "Caterpillar" Diesel engines to a long-established tractor chassis.

Even the engine used in the Diesel Thirty-Five is not new, as it differs only in horsepower and number of cylinders from the engines used in the "Caterpillar" Diesel Seventy-Five and Diesel Fifty tractors that have been in the field for many months. The engine in the Diesel Thirty-Five has the same bore and stroke, bearings, cylinder liners, connecting rods, pistons, wrist pins, front end drive, governor, fuel injection pumps, valves and valve mechanism that are used on the two larger "Caterpillar" Diesel engines.



New Caterpillar Diesel Thirty-Five

This standardization of design insures improved parts service to the owner, simplifies repairs and adjustments and effects marked manufacturing economies. The "Caterpillar" Diesel Seventy-Five tractor engine has six cylinders, the Diesel Fifty has four and the Diesel Thirty-Five has three cylinders, all manufactured on the same machines, employing the same parts and giving the same performance.

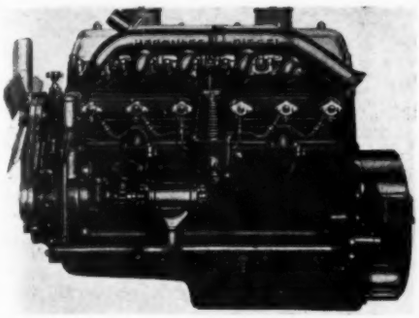
Full force feed lubrication, a statically and dynamically balanced crank shaft supported by four large main bearings, four forward speeds ranging from 1.7 to 4.6 miles per hour, and 13,900 lb. of weight balanced by approximately 2,000 sq. in. of traction are some of the other outstanding features of this new model. The standard machine has a 53-in. tread from center to center of the 14-in. tracks, and wide-gauge models with a 74-in. tread and track shoes of various widths are available for use on soft ground, steep hillsides or the cultivation of row crops. Positive starting under all conditions is assured by an auxiliary gasoline engine mounted on the left side of the block which cranks the Diesel engine through a Bendix, the arrangement used so successfully on the other "Caterpillar" Diesels.

The three-cylinder Diesel engine used in this tractor is also available as as self-contained power unit.

New Diesel Engine

The Hercules Motors Corporation, Canton, O., has developed a six cylinder solid injection, high compression, full Diesel engine for automotive, general industrial, agricultural, oil field and marine purposes. This engine is to be known as their Model DX1 and has 5-in. bore and 6-in. stroke, and is constructed to operate at speeds up to 2,000 r.p.m. Its design and construction follow the usual Hercules practice with particular attention being given to symmetry, compactness, and pleasing appearance, with accessibility, durability and reliability as most important requisites.

The crankshaft is of the underhung type and is supported by the crankcase which can be had of either aluminum or cast iron,



Hercules Model DX1 Diesel Engine

and which extends 4 in. below the crankshaft center, thus forming a deep tubular rib to give side stiffening to the case and to which is bolted a pressed steel oil pan. The crankcase extends above the crankshaft of sufficient height to give ample vertical stiffness to the case upon which is supported a one-piece cast iron cylinder block and two cylinder heads, each covering three cylinders. Through bolts from the main bearing caps pass through the crankcase, cylinder block and heads to clamp these members rigidly together and carry vertical stresses from the cylinder heads to the crankcase. The eccentric heads on these bolts which are located in recessed holes in the top of the crankcase, prevent the bolts from turning when the main bearing nuts or the cylinder head nuts are drawn up.

Because of the through bolt construction with the eccentric heads, any and all parts above the crankcase can be removed without disturbing the main bearing caps if occasion should ever require it.

In general, the external mounting dimensions have been made interchangeable with the well known Hercules HX series of the gasoline engines.

In reference to performance, the DX1 will develop from 100 hp. to 1,000 r.p.m. to 177 hp. at 1,800 r.p.m. and 188 hp. at 2,000 r.p.m. with a B. M. E. P. of 110.3 lbs., 109.6 lbs., and 105.5 lbs. respectively.

The fuel consumption is .383 lb. per brake horsepower per hour at 1,000 r.p.m. .430 lbs. per brake horsepower per hour at 1,800 r.p.m. and .46 lbs. per brake horsepower per hour at 2,000 r.p.m. with the above B. M. E. P.

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New Small Tape-Rule

"Aristocrat" No. 186 is the name of a new tape rule just put out by the Lufkin Rule Co., Saginaw, Mich. It is a practical 6 ft. measure for general work, yet weighs but two ounces and has case but 1⅝ in. in diameter. The steel line, which is stiffened

Lufkin "Aristocrat" Tape Rule

by special forming, can be projected unsupported, like a rule, to walls or into openings, yet will also flex around and accurately measure circles, etc. It is manually operated. Hook at first end is very handy when measuring, either within or beyond arms reach. No. 186 is graduated 72 in. to 16ths; No. 186D carries in addition engineer's measurement, i. e., feet, 10th and 100ths of feet.

The case is of stainless steel, very smoothly formed. Both sides have embossed design with background in black enamel. Individual box is attractive, in black and silver, transparent covered.

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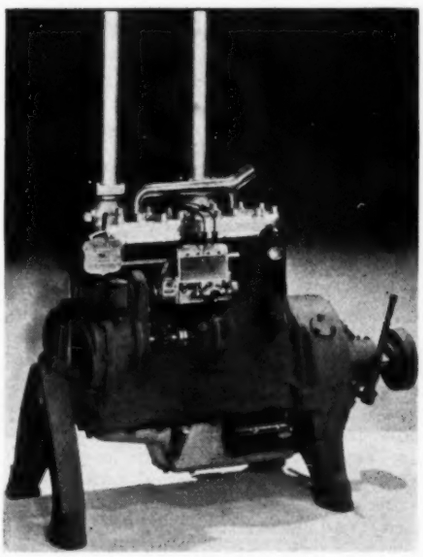
New Diesel

A new Diesel has recently been developed by the American Diesel Engine Co. of Oakland, Calif. This engine is of monovalve construction—using only one valve per cylinder. This permits the use of conventional L-head design.

This new 4-cylinder American diesel operates at a rated speed of 1,200 r.p.m. and develops 75 hp. at this speed. The fuel consumption at 75 hp. is .44 lb. per



New Diesel of American Diesel Engine Co.

horsepower hour. Since the torque curve on this engine is so flat and the fuel consumption so complete, it is stated to be practicable to run this engine over a speed range from 200 to 2,000 r.p.m. and still get a clear exhaust and a fuel consumption of less than .5 lb. per hp. hour.

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New Tractor Derrick

A new tractor derrick, for lifting or moving materials and equipment of all kinds in the field, in corporation yards and in storage depots, is announced by R. G. Le Tourneau, Inc., of Stockton, Calif., manufacturers of tractor equipment. Outstanding features, claimed for this new machine aside from its power, are its high speed of operation, its mobility, and the ease with which it can be attached to or removed from a tractor.

The machine can be taken practically anywhere a tractor can go, and can be operated wherever a tractor can get fairly solid footing. With the addition of a hammer and guides it can be used as a pile-driver. It interferes only slightly with use of the tractor for general purposes. The boom can be dismounted from the tractor-frame by removing two hinge pins and the tractor-frame can be removed from the tractor by loosening six bolts. It is not necessary, however, to remove the tractor-frame in order to use the tractor for other work, and the tractor can be used for hauling while the entire derrick is mounted on it. About 20 minutes' time is stated to be required to dismount the derrick.

The tractor is operated by the regular double-drum Le Tourneau power control unit, one drum raising or lowering the boom and the other the fall line. The regular tractor operator controls the derrick with the normal control levers of the power unit. As no change is required in the power unit, the derrick can be used easily on the same tractor used to operate a bulldozer or other equipment. Also this obviates the necessity for purchasing a separate power unit to be used with the derrick.

Although light in weight, the derrick is strongly constructed. Its rated maximum lift is 10,000 lbs. It is of welded steel construction throughout. All sheaves are carried on high-duty Hyatt roller bearings.

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Recent United States Patents Relating to Roads

Compiled by Patent & Technical Information Service, 1336 New York Avenue, N. W., Washington, D. C.

JUNE 6, 1933

1,912,429. **Paving Block and Method of Paving.** Edward W. Burgess, Milwaukee, Wis., assignor to A. O. Smith Corporation, Milwaukee, Wis. A pavement composed of a plurality of blocks, each having a plurality of arcuate dowel passages of equal radii in the edge portions thereof, a dowel passage of one block being disposed opposite a dowel passage in an adjacent block to form an arcuate dowel passage in the blocks both ends of which terminate in the surfaces, and a dowel pin disposed within the arcuate dowel passage for securing the blocks together.

1,912,546. **Grading and Aligning Device.** Carl A. Smith, Defiance, O. A device for setting road forms to adjustment, from engineer's stakes, comprising a frame including a grade and alignment member, supporting disposed transversely of the frame, and whereon the frame is slidable, longitudinally of the supports and transversely of the frame, means carried by the supports for sliding the frame longitudinally of the supports and transversely of the frame, to secure adjustment of said member with respect to the engineer's stakes, and vertically operating ground engaging grading devices carried by the supports, on opposite sides of the frame, and constituting means for adjusting said member to the grade established by the engineer's stakes.

1,912,897. **Road Machine.** Andre Huet, Paris, France, assignor to Societe Provia, Zug, Switzerland. A road surfacing machine of the character described comprising a wheeled frame, a steam generator carried by said frame,

means for directing the steam from the generator against the road surface, means for collecting dust and other loose material from the road surface, means carried by the frame for applying road coating material to the road, and means for mixing dust and other loose material into the road coating material.

1,912,976. **Machine for Mechanically Finishing Roadway Concrete Coverings.** Justin Andre Hector Fedi, Paris, France. A machine for finishing concrete roadway coverings comprising a frame, two longitudinal rollers journalled in the frame, an engine on the frame, means for temporarily displacing the two longitudinal rollers while rotating in either direction from the engine for driving, the machine resting on the said longitudinal rollers which progress transversely relative to the road, two transverse rollers mounted on the said frame, one of these rollers being a steering roller and the other driven temporarily in rotation from the said engine, means for raising or lowering one of the said rollers for allowing the machine to rest either on the longitudinal rollers or on the transverse rollers, as and for the purpose set forth.

JUNE 13, 1933

1,913,235. **Expansion Joint Member.** Norman P. Harshberger, Pasadena, Calif., assignor to Bakelite Building Products Co., Inc., New York, N. Y. An expansion joint member for use in paving, comprising a strip of fabric having a coating of material which has the characteristic of oozing under the influence of heat and pressure, said joint member being the tubular wound and flattened formation of said strip, the coating being on the inner side of the fabric and the closed edges of the member preventing loss of coating material from said edges.

1,913,690. **Roadway Guard.** Ralph J. Teetor, Cadillac, Mich., assignor to The Colorado Fuel & Iron Company, Denver, Colo. A highway guard fence comprising a series of posts, cables projecting forwardly from each post, a flexible barrier supported at the outer ends of the cables projecting from the posts and a connection between the cables of each post, separate from the barrier.

1,913,715. **Highway Guard.** Charles H. MacDonald, Denver, Colo., assignor to The Colorado Fuel & Iron Company, Denver, Colo. A highway guard fence comprising a series of posts, a pair of cables, means on intermediate posts of said series for supporting the cables forwardly thereof and in spaced relation to the surface in which the posts are set, a wire netting secured at its ends and carried by both cables, and similarly spaced from said surface, said netting being longitudinally yieldable intermediate its ends.

1,913,883. **Road Grader.** Orville Q. Hinds, Chicago, Ill., assignor to Allis-Chalmers Manufacturing Company, Milwaukee, Wis. In a road grader, a main frame, a mold board adjustably carried by the grader below the main frame, a mold board extension secured to the mold board at one end thereof so as to form substantially a single cutting member therewith, and a wing cutter adjustably pivoted to the end of the mold board extension.

1,913,897. **Road Material Speader.** Clyde G. Porterfield, Marion, O. A road material spreader comprising a straight-edge for lengthwise sliding movement along the longitudinal axis of a road, a rearwardly inclined front blade and a forwardly inclined rear blade secured to the straight edge and extending outwardly therefrom in converging relation, the straight edge extending forwardly and rearwardly beyond the inner ends of the blades, a carrier shaft arranged parallel to the axis of the triangle formed by the straight-edge and blades, means securing one end of the shaft to the blades near the outer ends of the latter, and means for suspending the shaft from a carrier.

JUNE 20, 1933

1,914,950. **Spreader for Road Surfacing Fluid.** Max Kanen, New Rochelle, N. Y. A spreader for spreading road surfacing fluid comprising a plurality of squeegee members each including a flexible sheet or pad and a metallic frame for supporting and rigidfying the same along its upper marginal edge, a plurality of vertically yieldable support members, means pivotally securing said squeegees to said support members in order to permit each of the squeegees to said support members in order to permit each of the squeegees to independently tilt or oscillate about a horizontal axis extending transversely thereof, resilient means urging each of said support members downwardly, means to prevent oscillation of the squeegees about a vertical axis, said plurality of squeegees being arranged in substantially end to end relation, whereby the squeegees are independently liftable and independently oscillatable in order to form a continuous squeegee surface which will accommodate irregularities in and the crown of a road being spread with surfacing fluid.

1,915,032. **Method and Means for Correcting Paving Settlements.** John W. Poulter, Mount Pleasant, Iowa, assignor to National Equipment Corporation, Milwaukee, Wis. The method of treating paving constructions which includes the step of forcing under the pavement a filling material in fluid form until the construction is elevated.

1,915,094. **Machine for Grading Roads and the Like.** Neil E. Jersey, Bucyrus, Ohio, assignor to W. A. Riddell Company, Bucyrus, Ohio. In a machine of the character described, the combination with a main frame and a tool supported therefrom, of means adjustably supporting said tool with respect to said frame, said means comprising an extensible link consisting of a plurality of relatively rotatable screw connected members respectively universally connected to said tool and said frame, and means mounted on said frame independently of said members and connected with one thereof to rotate the same irrespective of the position of said members.

1,915,105. **Grader.** George D. Shaeffer, Bucyrus, Ohio, assignor to W. A. Riddell Company, Bucyrus, Ohio. In apparatus of the character described, the combination of a wheel supported tubular reach, an earth working tool, means journaled on the periphery of said reach adjustably supporting said tool in a plane transversely of said reach, means for adjustably rotating and supporting said tool in angular relation to said plane, and means for securing said tool in its adjusted position.

JUNE 27, 1933

1,915.814. **Method of Constructing Asphalt Macadam Surface Courses.** Landon R. Mason, Los Angeles, and Fred E. Griffith, Long Beach, Calif., assignors, by mesne assignments, to William C. McDuffie. A method of constructing asphalt macadam surface courses, comprising, spreading and compacting by rolling a layer of coarse stone aggregate on a course, spraying the compacted layer of coarse stone aggregate with hot liquid asphalt containing pulverized diatomaceous earth and cementing the compacted layer of coarse stone aggregate in place, then spreading a layer of intermediate size stone aggregate over the cemented layer of coarse stone aggregate, and compacting by rolling the layer of intermediate size stone aggregate until the intermediate size stone aggregate is embedded and cemented into the voids of the coarse stone aggregate, spraying the surface of the compacted cemented layers of stone aggregates with hot liquid asphalt containing diatomaceous earth, then spreading a layer of stone aggregate and diatomaceous earth over the surface of the sprayed cemented layers of stone aggregates, and bonding by rolling the layer of stone aggregate and diatomaceous earth to the surface of the cemented layers of stone aggregates on the course.

1,915,844. **Road Grading Machine.** Mahlon D. York and Paul J. Newton, Unadilla, N. Y., assignors to York Modern Corporation, Unadilla, N. Y. In a road-grading machine having a frame and a road-working unit operatively connected thereto for relative vertical movement, separate piston-motors operatively connected to opposite ends of said unit for raising and lowering the same, a fluid supply tank, a fluid pressure tank, separate valve chambers one for each motor and each having a pair of ports in constantly open communication with opposite ends of the corresponding motor and an additional pair of ports in constantly open communication with the pressure tank and supply tank, respectively, and separately operable valves in said chambers each adjustable rotarily to different positions for simultaneously connecting each of the ports of one pair with either of the ports of the other pair for reversing the direction of flow of the fluid to and from the selected motor.